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ABSTRACTS

of recent published material on Soil and Water Conservation

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They are issued at irregular intervals, and their purpose is to bring together a summary of current published information about soil and water conservation for ready reference of those actively engaged in soil and water conservation work.

Distribution is handled by the Soil Conservation Service, the Agricultural Research Service, and cooperating agencies and institutions for their own personnel.

This is the FOURTEENTH of the publications issued under this title. Previous issues were published as follows:

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4.	USDA	PA-143,	November	1950*
5.	USDA	PA-173,	June	1951*
6.	USDA	PA-192,	December	1951*
7.	USDA	PA-213,	October	1952*
8.	USDA	PA-228,	July	1953*
9.	USDA	ARS-41-1,	December	1954*
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SOIL SCIENCE (BASIC)

Soil Physics

Allison, L. E. A STUDY OF SYNTHETIC AGGREGATE BREAKDOWN USING LOGARITHMIC-NORMAL DISTRIBUTION ANALYSIS. Soil Sci. Soc. Amer. Proc. 20: 314-316. 1956.

A logarithmic-normal plot of the size distribution of water-stable aggregates has been recommended as a valuable method for studying the mechanism of soil aggregate stability. This system of analysis was applied to a 4-year study of VAMA-treated Pachappa loam soil from 4 field plots in which the initial exchangeable sodium levels varied from 3 to 47%.

The log-normal plotting method for expressing the persistance of soil conditioner effects indicates directly the annual changes in the geometric mean aggregate diameter and the changes in standard deviation for aggregate-size distributions about the mean.

The highest degree of aggregation, due to VAMA treatment, was produced in the presence of moderate to high exchangeable sodium. However, the high-sodium aggregates appeared to break down more rapidly than those produced in the presence of low-exchangeable sodium.

Allison, L. E., and Moore, D. C. EFFECT OF VAMA AND HPAN SOIL CONDITIONERS ON AGGREGATION, SURFACE CRUSTING, AND MOISTURE RETENTION IN ALKALI SOILS. Soil Sci. Soc. Amer. Proc. 20: 143-146. 1956.

A laboratory study was made to determine the relative effectiveness of VAMA and HPAN polymers at 6 rates of application in producing high water-stable aggregation. Nine alkali soils and two nonalkali soils, obtained from experimental sites in six Western States, were used in this investigation.

VAMA conditioner proved appreciably more effective than HPAN conditioner, within the rates of application of 0.025 to 0.20%, for 8 of the 11 soils studies. For 3 soils, there appeared to be no significant difference between these 2 kinds of conditioners at any of the rates used.

The rate of application of polymers necessary for effective structure stabilization was found to be directly related to both the specific surface and the clay content of soil. Because of its simplicity, the determination of clay content by any satisfactory method is recommended as a guide to rate of polymer treatment for maximum aggregation.

As determined by modulus of rupture measurements, both types of conditioners were effective in ameliorating soil hardness, or the crusting tendency, of high-sodium soils, However, neither conditioner exhibited an appreciable effect on soil-moisture retention.

Allison, L. E. SOIL AND PLANT RESPONSES TO VAMA AND HPAN SOIL CONDITIONERS IN THE PRESENCE OF HIGH EXCHANGEABLE SODIUM. Soil Sci. Soc. Amer. Proc. 20: 147-151. 1956.

This paper summarizes two experiments with polyelectrolyte soil conditioners to determine their effect on an irrigated soil--Pachappa loam--having a high content of exchangeable sodium. The conditioners were applied at the 0.1% rate to a depth of 6 inches, with sufficient mixing to insure thorough incorporation of conditioner with soil. Sweet corn was used as the test crop.

The initial study was started in 1951 and continued for 4 cropping seasons. Treatment of high-sodium plots with VAMA in solution gave a large increase of aggregates larger than 0.10 mm. diameter, gave up to 10-fold increases in infiltration rate, and greatly reduced modulus of rupture values, resulting in increased emergence and stand of crops. Large increases in yield of sweet corn were obtained as a result of soil physical improvement. For the 4 annual crops, the average yield increases due to treatment were 75, 200, and 260% on 3 plots having initial exchangeable-sodium-percentages of 29, 40, and 47, respectively.

In a second and larger experiment begun in 1952, the VAMA and HPAN type of polyelectrolytes (100% active) and their respective clay formulations (25% active) were thoroughly incorporated as a dry treatment into moist soil. For high-sodium Pachappa loam soil and at the rates of application used, there appeared to be little or no difference in performance between the two types of conditioners or between formulations for a given type. Soil and crop responses due to treatment were similar to those obtained in the first experiment.

Sodium removal from the top 6 inches of soil, as a result of irrigation, was approximately twice as rapid on plots treated with conditioner as for plots not so treated. In the second experiment, the effect of the conditioner treatment in facilitating sodium removal was equivalent to a 2-ton application of gypsum.

Beacher, B. F., and Strickling, Edward. EFFECT OF PUDDLING ON WATER STABILITY AND BULK DENSITY OF AGGREGATES OF CERTAIN MARYLAND SOILS. Soil Sci. 80(5): 363-373. Nov. 1955.

Four series of laboratory tests were conducted in which water stability and bulk density of the aggregates of the 4.67 to 6.72 mm. size range of certain Maryland soil types were determined before and after puddling and other treatments that involved working the soil but did not necessarily increase its bulk density. The data disclosed that water stability of soil aggregates is significantly reduced by puddling and other treatments that disrupt natural structure. Bulk density of the aggregates is significantly altered by puddling and other treatments. It may be measurably larger or smaller in the treated samples than in the natural soil aggregates, depending on the nature of the treatment and the moisture status of the sample during treatment. Addition of the bonding agent vinyl acetate-maleic acid to disturbed samples restored aggregate stability, but bulk density was less than in the material soil aggregates. Significant negative and positive correlations were computed between degree of aggregation and bulk density. Alteration of bulk density is probably not the controlling factor causing the change in aggregate stability. The application and limitations of capillary rise equations to explain the water-stability of soil aggregates are discussed, and an energy concept of soil aggregation is suggested to offer a more fundamental approach.

Bloodworth, M. E., Page, J. B., and Cowley, W. P. SOME APPLICATIONS OF THE THERMOELECTRIC METHOD FOR MEASURING WATER FLOW RATES IN PLANTS. Agron. Jour. 48(5): 222-228. May 1956.

Maximum transpiration rates for cotton plants were found to occur when relative humidities varied between 42 and 50 percent, temperatures from 95 to 100 F., and wind velocities between 1 and 4 miles per hour. Soil moisture tension appeared to control absorption and movement of water in plants.

Brooks, R. H., Bower, C. A., and Reeve, R. C. THE EFFECT OF VARIOUS EXCHANGEABLE CATIONS UPON THE PHYSICAL CONDITION OF SOILS. Soil Sci. Soc. Amer. Proc. 20: 325-327. 1956.

The effect of various exchangeable cations upon soil physical conditions was studied using eight soils. The stability of structure and crusting tendency of soils were evaluated by the air-water permeability ratio and modulus of rupture tests, respectively. The effects of exchangeable magnesium on soil physical conditions were compared with those of exchangeable sodium and potassium, which were previously reported. In addition, the results of similar tests with various combinations of exchangeable sodium and potassium are given. The effect of the various cations on the dispersion and leaching of organic matter was also studied.

Although there was a slight increase in modulus of rupture with increasing exchangeable magnesium, the data strongly indicate that exchangeable magnesium and potassium are similar to exchangeable calcium in their effect on stability of soil structure.

The fraction of organic matter that dispersed and leached from the samples saturated with the various cations was relatively small, and there was no significant difference between the amounts leached from the calcium- and magnesium-saturated soils.

Burgy, R. H., and Luthin, J. N. A TEST OF THE SINGLE- AND DOUBLE-RING TYPES OF INFILTROMETERS. Amer. Geophys. Union Trans. 37: 189-192. 1956.

The results of field experiments with ring-type infiltrometers are reported. Infiltration rates obtained with the rings were compared to the infiltration rates obtained by flooding the entire area to determine the number of ring measurements required to characterize the infiltration rate of the area. It was found on a uniform soil profile having no layers restricting the downward movement of water that six infiltrometers gave an average figure that was within 30 percent of the true mean. The single-ring infiltrometers were compared with the double-ring infiltrometers. There was no significant difference in the results obtained with the two types of infiltrometers on a uniform soil under the conditions of the tests.

Cooper, A. W., Vandenberg, C. E., McCally, H. F., and Erickson, A. E. STRAIN GAGE CELL MEASURES SOIL PRESSURE. Agr. Eng. 38: 232-235; 246. 1957.

The type A pressure cell reported in this paper will measure pressure with a reasonable degree of accuracy when suspended in a relatively homogeneous soil mass. A thick pressure cell gives a reading because the soil around the cell compacts, and the cell does not compress, causing a concentration of pressure on top of the cell.

According to calculations using Froehlich's formula, deep soil compaction is a function of the total load applied to the surface of the soil and the area over which it is applied. It is not a function of the unit pressure applied to the soil surface alone.

Data reported show that a rear tractor tire containing an air pressure of 16 p. s. i. applied an average pressure of 54 p. s. i. to the soil. Pressures as high as 43 p. s. i. were measured in the soil at approximately 2-inch depth. This soil was very dense, and the entire weight on the rear axle of the tractor was carried on the lugs of the rear tires.

Copeland, Otis L., Jr. A STUDY OF THE INFLUENCE OF MOISTURE AND COMPACTION ON SOIL OXIDATION-REDUCTION POTENTIALS. Soil Sci. Soc. Amer. Proc. 21: 269-271. 1957.

The effects of 2 moisture levels and 2 degrees of compaction on the oxidation-reduction potentials of 17 soils were investigated during an incubation period of 8 weeks. Soils receiving the optimum moisture-no compaction treatment maintained the highest potentials throughout the incubation period, while the saturated-high compaction series developed the lowest potentials. Apparently, the Hagerstown soil used in this study possesses a high degree of poise against reducing conditions. This is shown by the failure of drastic treatments involving compaction and saturation to lower the potentials by large values. The positive poising capacity is attributed to large quantities of hydrated iron oxides present within the soil, coupled with the paucity of active organic matter.

Corey, A. T. MEASUREMENT OF WATER AND AIR PERMEABILITY IN UNSATURATED SOIL. Soil Sci. Soc. Amer. Proc. 21: 7-10. 1957.

Equipment developed for the measurement of oil and gas flow in oil producing sands was used to study unsaturated permeability in a soil. The method employs the simultaneous flow of air and water under the same pressure gradient to maintain a uniform tension and, as a consequence, a uniform saturation within the sample during permeability measurements. The saturation is reduced in increments by reducing the water pressure with respect to the air pressure.

Results of unsaturated permeability measurements on two relatively undisturbed samples of a sandy soil are presented. The interrelationship between gas and liquid permeabilities as a function of saturation is discussed, and a method of calculating the unsaturated water permeability from the more easily measured air permeabilities is suggested. The magnitude of gas slippage in a dry soil sample was determined by measuring the air permeability at several mean pressures and extrapolating the air permeability-mean pressure function to an infinite pressure. The permeability to water of the saturated soil was only about half the permeability to air of the dry soil even when the air permeability was corrected for slippage.

De Plater, C. V. A PORTABLE CAPACITANCE-TYPE SOIL MOISTURE METER. Soil Sci. 80(5): 391-395. Nov. 1955.

A portable meter is described for the rapid determination of soil moisture in terms of electrical capacitance. The meter is designed for use with a probe.

Emporon, P. R., and Tysdal, H. M. THE EFFECT OF LIGHT AND OTHER FACTORS ON BREAKING THE DORMANCY OF GUAYULE SEED. Agr. Jour. 49: 15-19. 1957.

Exposure to light for 3 to 4 days during germination, plus the oxidation brought about by using 3/4 percent sodium hypochlorite, completely broke the dormancy of guayule seed so that freshly harvested achenes gave maximum germination equal to that after 84 days of storage. The effect of light and hypochlorite are additive. Age of the achene may decrease hypochlorite concentration requirement. Optimum temperatures were 30 to 20° C. Light and sodium hypochlorite did not conteract temperature variations. Light had no adverse effect on achenes which were past the dormancy stage.

Fayemi, A. A. EFFECT OF TEMPERATURE ON THE RATE OF SEED SWELLING AND GERMINATION OF LEGUME SEED. Agronomy Jour. 49: 75-76. 1957.

Temperature and moisture are two of the important factors in germination and seed swelling. The rate of seed swelling of legume seeds was greatly influenced by temperature. The time for exposure to the initial absorption of water by the seeds became shorter as the temperature increased. Crimson clover was an exception.

Gardner, W. R. REPRESENTATION OF SOIL AGGREGATE-SIZE DISTRIBUTION BY A LOGARITHMIC-NORMAL DISTRIBUTION. Soil Sci. Soc. Amer. Proc. 20: 151-153. 1956.

Over 200 aggregate-size distributions which have appeared in the soils literature were examined to determine if they could be fitted by an analytical expression. A majority of these distributions was found to be logarithmic-normal or very nearly so. Such distributions can be completely characterized by specifying the geometric mean diameter and standard deviation. The logarithmic-normal distribution function and its application to aggregate-size distributions are discussed. An illustrative example is given.

Gill, W. R., and Miller, R. D. A METHOD FOR STUDY OF THE INFLUENCE OF MECHANICAL IMPEDANCE AND AERATION ON THE GROWTH OF SEEDLING ROOTS. Soil Sci. Soc. Amer. Proc. 20: 154-157. 1956.

Apparatus was developed to permit simultaneous study of the effects of two of the factors regarded as responsible for the poor growth of roots in some compacted soils. The other factors were purposely minimized by the use of glass beads and tap water as the substrate and sterilized, freshly germinated corn seedlings as the plant material. The factors investigated were mechanical and oxygen supply to the root. Although the mechanical impedance imposed could not be precisely stated, the control of the soil atmosphere was excellent. It was found that the rate of growth of unimpeded roots declines when the oxygen content falls below 10% and that the growth of impeded roots is seriously reduced under these conditions. Microscopic examination of roots grown under conditions of severe mechanical restraint have not yet revealed reliable symptoms of impedance other than a distortion of the normal shape.

Gist, G. R., and Mott, G. O. SOME EFFECTS OF LIGHT INTENSITY, TEMPERATURE, AND SOIL MOISTURE ON THE GROWTH OF ALFALFA, RED CLOVER, AND BIRDSFOOT TREFOIL SEEDLINGS. Agron. Jour. 49: 33-36. 1957.

The growth response from increased light on alfalfa, red clover and birdsfoot trefoil seedlings in growth chambers was curvilinear for tops and linear for roots. Root growth was affected more than top growth by reduced light intensity. Increasing temperatures from 60° to 90° F. reduced seedling growth. Decreasing soil moisture reduced seedling growth correspondingly. Red clover was affected less by reduced light than alfalfa and birdsfoot trefoil. There was less growth of birdsfoot trefoil than the other two species.

Hanks, R. J., and Harkness, K. A. SOIL PENETROMETER EMPLOYS STRAIN GAGES. Agr. Engr. 37(8): 353-354. Aug. 1956.

By replacing the penetrometer probe, in the apparatus used by Richards, with a rod bored to fit over the 3/8-inch steel ball of the sample breaking machine, the penetrometer was used successfully to measure the modulus of rupture of soil.

Hanks, R. J., and Thorp, F. C. SEEDLING EMERGENCE OF WHEAT AS RELATED TO SOIL MOISTURE CONTENT, BULK DENSITY, OXYGEN DIFFUSION RATE, AND CRUST STRENGTH. Soil Sci. Soc. Amer. Proc. 20: 307-310. 1956.

Wheat seedling emergence was measured on three soils varying in texture from a silty clay loam to a fine sandy loam with different combinations of soil moisture, bulk density, oxygen diffusion rate, and crust strength. The ultimate seedling emergence was nearly the same when the moisture content was maintained between field capacity and the wilting percentage, if other factors were optimum for maximum seedling emergence. The rate of seedling emergence, however, was related directly to the moisture content in the moisture range studied. Bulk density was varied from optimum to maximum field compaction. The data indicate that bulk density was related indirectly to seedling emergence in that any change in bulk density changed other factors such as oxygen diffusion rate and soil crust strength. Oxygen appeared to be a limiting factor whenever the oxygen diffusion rate was below 75 to 100 x 10^{-8} g./cm.^{2}/min. This corresponded to air pore space of about 16% or lower in the silty clay loam and to 25% or lower in the fine sandy loam. Crust strength, as measured by modulus of rupture, apparently limited seedling emergence in the dryer end of the available moisture range. The limiting crust strength was between 200 and 500 millibars and appeared to decrease as the amount of available moisture decreased.

Hemwall, J. B., and Low, P. F. THE HYDROSTATIC REPULSIVE FORCE IN CLAY SWELLING. Soil Sci. 82: 135-145. 1956.

Pressure-volume curves and unfrozen water at -5.0 C. were determined for clay gels which had the exchange complex saturated with sodium, thorium, and a mixture of sodium and thorium. The replacement of sodium by thorium on the clay surface was thought to reduce the number of osmotically active cations in the gel and, thereby, reduce swelling and the quantity of unfrozen water. The results of potentiometric and conductometric titrations, electrophoretic mobility measurements, and an X-ray diffraction analysis indicated that thorium was less dissociated than sodium from clay surfaces. In keeping with theory, as cation dissociation from the clay was decreased by replacing sodium with thorium, both swelling and the amount of unfrozen water were also decreased.

Jarvis, N. L., Dragsdorf, R. D., and Ellis, R., Jr. QUANTITATIVE DETERMINATION OF CLAY MINERAL MIXTURES BY X-RAY DIFFRACTION. Soil Sci. Soc. Amer. Proc. 21: 257-260. 1957.

The quantitative determination of clay minerals by X-ray diffraction procedures was investigated using MgO as an internal standard. The determination of intensity constants for the 001 diffraction lines of samples of illitic, kaolinitic, and montmorillonitic types of clay was made with reference to the 1.48 Å MgO diffraction line. These constants were calculated using the integrated intensity of the specified diffraction lines, the known weights of clay and MgO in each sample, and the calculated value for the intensity of the MgO line. For kaolinitic and illitic types of clay the constants were evaluated with less than 2% average deviation, whereas for the montmorillonitic types the average deviations varied from 2 to 5%, depending upon the clay sample used. The values of the constants vary quite markedly from one species of clay mineral to another within each general clay type and, therefore, constants must be determined for each of the various clay species when they occur in a sample to be investigated.

From the intensity constants for the diffraction lines of each clay specie present in a mixture and the integrated intensity of the respective lines, the percentage composition of known synthetic mixtures of two and three components was determined with an average deviation of 1.87% from the actual composition. It was found that clay constituents appearing in quantities less than 10% by weight gave considerably larger deviations, and in the case of such small quantities of illitic types, the diffraction line often could not be differentiated from the background radiation.

Jumikis, A. R. THE METHOD OF SOLUTION OF RUCKLI'S FROST-PENETRATION EQUATION. Amer. Geophys. Union Trans. 37: 181-184. 1956.

The purpose of this article is to present the author's method of solving a non-linear differential equation given by R. Ruckli expressing the rate of frost penetration in soil. There is no standard method of solution of such a differential equation as set up by Ruckli, yet the method of solution of the non-linear differential equation, not given by Ruckli, is considered to be of great interest to the engineering profession in treating frost-penetration problems in highway and airport engineering.

The author's method of solution of Ruckli's equation for the frost-penetration rate consists of the application and use of power series and the determination of the coefficients involved, thus showing how to arrive at the integral which Ruckli presents as the end result of his non-linear differential equation. The author's thought behind the showing of the method of solution of the equation is not merely to demonstrate the application of so powerful a mathematical tool as the power series for solving engineering problems. According to his belief, it also helps one better to understand the phenomena, nature, and physical processes conveyed by this equation, it enables one better to analyze the problem involved, and establishes in the reader a certain confidence when applying the end result (integral) of Ruckli's equation. In addition, the presentation of this article naturally calls attention to the important work done by Ruckli.

Marshall, T. J. A PLUMMET BALANCE FOR MEASURING THE SIZE DISTRIBUTION OF SOIL PARTICLES. Australian Jour. Appl. Sci. 7(2): 142-147. 1956.

A simple balance is described for use with a plummet in measuring the density of soil suspensions. The only manipulation required is to adjust for depth of immersion of the plummet. The percentage of soil in suspension at a depth and time is read on a scale by means of a pointer. Suitable calibration procedures are given and some factors affecting the measurements are discussed.

McClelland, J. H. INSTRUMENT FOR MEASURING SOIL CONDITIONS. Agr. Engin., Vol. 37, No. 7, pp. 480-481. July 1956.

The instrument in this paper is a soil probe or continuously recording horizontal penetrometer devised for evaluating mechanical properties of the soil familiar to the engineer, including shear strength, cohesion, adhesion, particle and pore size and distribution and resistance to vertical penetration.

Neller, J. R., and Bartlett, F. D. EFFECT OF PARTICLE SIZE ON AVAILABILITY AND MOBILITY OF FUSED TRICALCIUM PHOSPHATE AND ROCK PHOSPHATE COMPARED WITH OTHER PHOSPHATES IN CONTRASTING SOIL TYPES. Soil Sci. Soc. Amer. Proc. 21: 189-192. 1957.

The availability of the phosphorus of fused tricalcium phosphates of 10- and 40-mesh sizes was compared with that of the phosphorus of dicalcium phosphate, basic slag, and of rock phosphates ground so that 85% for one lot and 50% of the other passed the 200-mesh sieve. The experiments were conducted in lysimeters and in the greenhouse.

Growth of millet on Leon fine sand, limed to pH 5.8, was decidedly better for the fused tricalcium and the dicalcium phosphates than for the rock phosphate. One-third of the phosphorus of the dicalcium and 40-mesh tricalcium phosphates, 1/8 of the phosphorus of the 10-mesh tricalcium phosphate, and less than 1/100 of the phosphorus of rock phosphate was found in the leachates. Growth of corn or limed Leon fine sand was significantly better for the 40-mesh than for the 10-mesh tricalcium phosphates. Growth of corn in limed Tifton fine sandy loam was about the same for both phosphates and for basic slag. Corn growth on non-phosphated portions of these soils exhibited a marked phosphorus deficiency. Phosphorus deficiency symptoms were also present on the phosphated Tifton fine sandy loam and the phosphorus content of the corn leaves was less than 0.1%.

Radioactive superphosphate was used to compare the availability of the phosphorus of 10- and 40-mesh fused tricalcium phosphates and triple superphosphate. Uptake of the labelled phosphorus by oats on Leon fine sand was less where superphosphate had had been used. The reverse was true for Red Bay fine sandy loam. This indicates that the phosphorus of the superphosphate went into solution quicker than that of the tricalcium phosphates and was more quickly immobilized by the fixation activities of the soil. The phosphorus of the 40-mesh tricalcium phosphate was somewhat more available than that of the 10-mesh but not significantly (LSD 0.05).

Pratt, P. F., and Shoemaker, H. E. ACID- AND ALKALI-SOLUBLE PHOSPHORUS IN RELATION TO SOIL REACTION. Soil Sci. 80(5): 381-389. Nov. 1955.

Samples of six acid soils were incubated for 14 months with various quantities of lime. Measurements of the acid-soluble and alkali-soluble P after incubation indicated that liming did not alter the system in which alkali-soluble P predominated to one in which acid-soluble P predominated. At pH values near or above neutrality, however, there were increases in acid-soluble P and decreases in alkali-soluble P with increase in pH of the soil. Recovery of added P indicated a much greater accumulation of added P in the acid-soluble form at pH values of near or above neutrality than was the case for the soil phosphorus.

Reeder, S. W., and McAllister, A. L. A STAINING METHOD FOR THE QUANTITATIVE DETERMINATION OF FELDSPARS IN ROCKS AND SANDS FROM SOILS. Canad. Jour. Agr. Sci. 37: 57-59. 1957.

A speedy and accurate staining procedure for the quantitative determination of the feldspars in rocks and sands of soils is proposed. The minerals are treated, by direct contact, with 48 percent hydrofluoric acid, and then immersed in a concentrated sodium cobaltinitrite solution which stains the potash feldspars yellow. This treatment is followed by immersion in a buffered hematein solution which stains the plagioclase feldspars purple. The depth of colour on the plagioclase depends upon the position in the isomorphous series. Quartz, gypsum and calcite are not affected by the treatment.

The quantity of the potash and plagioclase feldspar present is then easily determined by grain counts under the petrographic microscope.

Richards, L. A., and Ogata, Gen. MATERIALS FOR RETAINER PLATES AND THEIR USE FOR RETENTIVITY MEASUREMENTS. Soil Sci. Soc. Amer. Proc. 20: 303-306. 1956.

The selection of ceramic materials suitable for use as sample retainer plates is discussed. Methods for measuring the permeability, air-bubbling pressure, and air-entry pressure of retainer plates are given. The transfer conductance between retainers and a ceramic suction control surface is satisfactory if the contacting surfaces are reasonably flat and clean. Several tests have consistently indicated, however, that better results are obtained if a capillary contact medium is used when ceramic retainer plates are used on cellulose membranes. The retentivity at high suctions for cores may be significantly different than for air-dried and fragmented soil. For example, the average 15-bar percentage for 7 cores of sandy loam soil was 5.96, whereas the average 15-bar percentage for the soil in these cores after air drying and fragmenting was 5.48, the difference being highly significant. Tests indicate that the water-release curves for cores of a fine sandy loam soil that were wetted in the field by flood irrigation are the same as when the same cores are wetted to zero suction in the laboratory.

Richards, L. A. SAMPLE RETAINERS FOR MEASURING WATER RETENTION BY SOIL. Soil Sci. Soc. Amer. Proc. 20: 301-308. 1956.

The relation of the water content of soil to suction may be determined by use of suction control surfaces, ceramic or cellulosic, in pressure chambers. Advantage is gained for these measurements by placing the sample under test in a retainer having a porous ceramic bottom plate. Retainers for use with core and fragmented samples are described and procedures are given for their use.

Richards, L. A., Gardner, W. R., and Ogata, Gen. PHYSICAL PROCESSES DETERMINING WATER LOSS FROM SOIL. Soil Sci. Soc. Amer. Proc. 20: 310-314. 1956.

A field plot of uniform fine sandy loam free of plants was deeply irrigated with water containing 44 me./l. of chloride. The water and chloride content of the soil and the hydraulic head were measured as functions of depth and time for 59 days during summer.

The water content, W, of surface layers of soil of thickness from 10 to 50 cm. were functions of time, T, that could be closely represented by equations of the form $W = aT^{-b}$. This means that the rate of loss of soil water was inversely proportional to time after irrigation. Making use of this equation and its derivative with respect to time, it is possible to calculate the vertical water-flow velocity in the soil at various times and depths. Capillary conductivity values were calculated and agreed closely with published values obtained by steady state laboratory methods of soil from an adjacent area.

The evaporation from the soil surface over the 59-day period of record was obtained from the water content of the 0- to 40-cm. soil layer by subtracting the downward drainage calculated from hydraulic gradient and capillary conductivity values. The evaporation thus obtained was 5.6 cm. The evaporation was also independently calculated from the change in water content and chloride content of the 0- to 10-cm. layer of soil. This method gave an evaporation figure of 6.0 cm.

Early in the test period a marked decrease in the concentration of chloride in the soil solution developed in the 5- to 10-cm. depth interval. This depth interval apparently corresponds to a zone of condensation of water vapor that moves downward from the overlying and warmer surface layer of soil. However, after taking negative adsorption into account, it was concluded from the vertical distribution of chloride in the soil and the change of this distribution with time that the water transferred in the vapor phase below the 10-cm. depth in the profile was of negligible agricultural significance under the conditions of the test.

Sabey, B. R., Bartholomew, W. V., Shaw, R., and Pesek, J. INFLUENCE OF TEMPERATURE ON NITRIFICATION IN SOILS. Soil Sci. Soc. Amer. Proc. 20: 357-360. 1956.

Nitrification of ammonium sulfate as influenced by temperature was studied in 3 Iowa soils in the laboratory and in 1 soil under field conditions over a fall and winter season. Laboratory temperatures ranged from 8° to 30°C. and soil temperature in the field varied from freezing to about 20° C.

General relationships were established between temperatures and nitrification rates in given soils. Nitrification rate decreased with diminution in soil temperature; however, the relationship was not linear over the entire temperature range. At given temperatures, ammonia oxidation rates differed between soils studied, but the temperature-nitrification rate curves for the 3 soils were similar and differed only by a constant factor.

Of particular importance to this study was the influence exerted on nitrification by temperature as it decreased from optimum to critically low temperatures. Complete inhibition was not attained until soil temperatures approached the freezing point. Only slight oxidation of ammonium occurred, however, under field conditions in soils that were fertilized after soil temperatures had decreased below 50° F.

Shaw, R. H., and Runkles, J. R. SOIL MOISTURE AND WATER UTILIZATIONS IN IOWA. Agron. Jour. 48(7): 313-318. July 1956.

Average water loss per day by runoff, percolation, and evapo-transpiration was 0.04 to 0.05 in winter and 0.18 to 0.20 inches in summer from samples taken in Iowa between Feb. 1954 and Nov. 1955. There was little change in soil moisture content in winter. Small gains in Spring were greater in corn than meadow. Decrease in summer was greater under corn than meadow, amounting to 3 to 4 inches. Normal rainfall increased soil moisture content 2 to 3 inches in late summer and fall.

Staple, W. J. EVAPORATION FROM SOIL AND VEGETATION. Netherlands Jour. Agr. Sci. 4: 39-42. 1956.

Some results of 28 years' measurements of moisture conservation and use in soil tanks and field plots are described. Most of the rainfall received in southwestern Saskatchewan is soon returned to the atmosphere from bare soil or by transpiration from crops. Only 21 percent of the precipitation is conserved in summerfallow during the 21-month summerfallow period. Wheat yield is determined largely by the moisture stored in the soil at seeding time and by the subsequent rainfall. Rough estimates of evaporation from soil can be made under semi-arid conditions, such as in southwestern Saskatchewan, on the basis of predetermined evaporation curves giving the loss for different soil moisture conditions.

Detailed data on capillary conductivity and diffusion coefficients are needed for computing moisture movement through soil to an evaporating surface.

Swanson, C. L. W., and Jacobson, H. G. M. EFFECT OF SOIL HARDNESS AND COMPACTION ON CORN GROWTH. Soil Sci. Soc. Amer. Proc. 20: 161-167. 1956.

A Proctor soil plasticity needle was modified so that the hardness of the soil surface in field plots could be measured. The instrument is simple in construction and penetration measurements can be made easily and quickly. Readings were taken before spring plowing, after the 2nd and 3rd cultivation, at first tassel, at the early milk stage, and at the dent stage of corn growth. Surface soil hardness through the growing season was in the order of 3 cultivations <2, 4-D + 1 cultivation <noncultivated (2, 4-D only). Surface hardness was correlated with average corn yields for a 3-year period. Data on the number of strokes (force) required to penetrate the soil at 0 to 2 and 4 to 6-inch depths for taking core samples confirmed the penetrometer data. Corn yields varied inversely with the number of strokes. The area traversed by the rear tractor wheel in cultivation is more compact than the area between hills; the 0 to 2-inch depth is less compact than the 4 to 6-inch depth. Plots sidedressed with N generally showed less compaction than nonsidedressed plots. Production and uptake of NO_3-N was in the order of 3 cultivations <2, 4-D + 1 cultivation noncultivated <noncultivated being inversely correlated with soil hardness. Nitrates accumulated in the tractor wheel area. Apparently, sidedressings of N on soils with poor structure is no substitute for soils in good tilth for increasing corn yields. A soil conditioner chemical (VAMA) adversely affected soil structure, decreasing corn yields. It is suggested there are 5 horizontal and 2 vertical zones of soil hardness or compaction in some cultivated soils.

Swartzendruber, Dale, and Kirkham, Don. CAPILLARY FRINGE AND FLOW OF WATER IN SOIL. Soil Sci., Vol. 81, No. 6, pp. 473-484. June 1956.

When a capillary fringe increases the length of each line of flow system without increasing the area perpendicular to the lines of flow, then the total flow through the system with the fringe will be less than it would be without the fringe. This behavior is qualitatively explanable on the basis of a vertical capillary tube mode. When a capillary fringe increases the size of a flow system in a direction perpendicular to the lines of flow as they exist without the fringe, then the total flow through the system with the fringe will be more than it would be without the fringe.

Taylor, S. A., and Haddock, J. L SOIL MOISTURE AVAILABILITY RELATED TO POWER REQUIRED TO REMOVE WATER. Soil Sci. Soc. Amer. Proc. 20: 284-288. 1956.

A deficit of water in plant root tissues sets up forces across the root surface membrane causing movement of water into the plant. As the removal increases, the forces get stronger; this normally causes water to move into the plant rapidly. The work per unit time that must be expended to remove a unit volume of water from the soil is here defined as the water extracting power.

Some theoretical predictions are made and partially verified by experiment. They are:

1. When moisture tension is uniform, the rate of removal of water at any depth is proportional to the root activity at that depth.

2. The amount of water extracted from any depth interval in the soil is inversely related to the power required to remove water in that interval. For a time after an efficient irrigation, water will be held at low tensions and the rate of water uptake will be more or less proportional to the activity of roots. This results in a more rapid increase of soil moisture tension in the zone where root concentrations are higher, which increases the power needed to remove water. Subsequently, more water is taken up faster from regions where root activities and soil moisture tensions are lower, and the average distance over which water moves and the velocity with which it moves are greater.

3. In order to attain equal rates of water extraction from all depths of the profile, a soil moisture tension gradient must be established which will be characteristic of the activity and growth rate for the crop.

4. When tension gradients have been established in the soil, there occurs a slow adjustment of moisture in the soil to decrease these gradients. This adjustment is proportional to the magnitude of the gradient and the conductivity of the soil for moisture. The slow movement of water through the soil to the plant roots might result in an appreciable removal because the absorbing surfaces of the roots are large.

Root activity is defined as the product of the absorbing surface of uniform roots by a characteristic permeability factor and summed over all roots in any given volume of soil. The age, rate of elongation, and concentration of roots are implicitly included.

Telfair, D., Garner, M. R., and Miars, D. THE RESTORATION OF A STRUCTURALLY DEGENERATED SOIL. Soil Sci. Soc. Amer. Proc. 21: 131-134. 1957.

Common agricultural practices contribute to the loss of favorable soil structure. On the other hand, certain natural forces appear to contribute to the recovery of porosity and tilth. These include wetting and drying, freezing and thawing, the effects of root growth and decay, and the activity of soil organisms.

In order to learn more about the nature and interplay of these forces, a method was developed for studying structural changes in buried cores of compacted soil. The technique of preparing these with various additives is described. The cores were buried under three types of cover: Forest, grass, and clean cultivation. The additives were fresh organic matter, lime and fertilizer, and an insecticide.

During a 2-year period the following relationships have come to light:

1. A platy structure forms as a result of wetting and drying, and plant roots tend to enter the shrinkage cracks.
2. Earthworms and other small invertebrates are active in transporting and mixing the core soil with surrounding soil, particularly with added organic matter.
3. Added organic matter results in a rapid increase in aggregate stability, followed, under cultivated conditions, by a seasonally fluctuating decline.
4. Changes take place more slowly under forest cover than in an open field.

The restorative process appears to be essentially a result of the interaction of physical and biological factors.

Weaver, H. A., and Pearson, R. W. INFLUENCE OF NITROGEN FERTILIZATION AND PLANT POPULATION DENSITY ON EVAPOTRANSPIRATION BY SUDAN GRASS. Soil Sci. 81(6): 443-451. June 1956.

Evapotranspiration rates by Sudan grass grown in Lloyd clay at two levels of soil moisture, three levels of plant density, and two levels of nitrogen were observed for a 1-month period, during which the plants grew from a height of about 2 inches to maturity for hay.

Evapotranspiration rate was affected very little by nitrogen level, but it was influenced appreciably by plant population level. Water use efficiency, however, was greatly increased by application of nitrogen, which produced a relatively heavy growth of grass without appreciable change in total evapotranspiration. An over-all linear increase in efficiency with population increase also occurred.

Evapotranspiration rates were appreciably greater for all treatments and periods at the high level of soil moisture than at the low level.

Minimum evapotranspiration for all treatments occurred during the first week, when water availability was relatively low for both levels of soil moisture, climatic factors favored low evaporation, and the plants were small. Maximum rates occurred during the second and third weeks, and a general decline took place in the fourth week, when plants entered the early dough stage.

Calculated evapotranspiration rates for the 6- to 7-day periods were not correlated with actual rates for this short-season crop. The calculated total values for the month, however, were about in line with actual values where soil moisture was not limiting.

Soil Chemistry

Black, C. A., and Scott, C. O. FERTILIZER EVALUATION: I. FUNDAMENTAL PRINCIPLES. Soil Sci. Soc. Amer. Proc. 20: 176-179. 1956.

Evaluation of different fertilizer sources of a common nutrient is discussed in relation to the principles of quantitative biological assay. Criteria for examining the comparative effects of different fertilizers are described. Fertilizer effects are classified into different categories on the basis of these criteria. An approach is described for extending the methods of classical biological assay to cover certain practical cases that do not meet the theoretical requirement.

Black, C. A., Webb, J. R., and Kempthorne, O. FERTILIZER EVALUATION: III. AVAILABILITY COEFFICIENT OF WATER-SOLUBLE AND CITRATE-SOLUBLE PHOSPHORUS IN ACIDULATED PHOSPHATE FERTILIZERS. Soil Sci. Soc. Amer. Proc. 20: 186-189. 1956.

A method is described by means of which the availability coefficient of citrate-soluble relative to that of water-soluble phosphorus may be evaluated when mixtures of the two phosphorus fractions are present in different proportions in two or more fertilizers. Knowledge of the relative availability coefficients of these two fractions, together with knowledge of the percentage content of the fractions, permits prediction of the relative availability coefficients of phosphorus in the different fertilizers. Application of the method to data obtained from experiments in which superphosphate and various nitric phosphates were compared as sources of phosphorus for corn showed that the ratio of the availability coefficient of citrate-soluble phosphorus to that of water-soluble phosphorus decreased from 0.85 to 0.16 as the fraction of the fertilizer phosphorus in citrate-soluble form increased from 0.56 to 0.95.

Blue, W. G., and Eno, C. F. MAGNESIUM AND LIME ARE NEEDED IN THE SUWANNEE VALLEY AREA. Univ. Fla. Agr. Expt. Sta. Bull. 577. August 1956.

The reaction of soils in the Suwannee Valley area generally varies between pH 5.1 and 5.7. For most crops grown in the area, except tobacco, and for adequate microbiological activity, a reaction near pH 6.0 is desirable. Since a liming program is needed for many soils in this area and since the magnesium, calcium and pH of such soils are generally low, dolomitic lime should be used. One thousand pounds of dolomitic lime per acre generally will be a satisfactory application for these light-textured soils, unless lime has been applied recently.

Since soil pH varies considerably from one field or farming area to another, the safe procedure would be to take soil samples prior to liming and determine pH and magnesium and calcium contents. Soil samples are analyzed and recommendations for soil treatment are made at the Soil Testing Laboratory, Soils Department, Gainesville.

Brown, J. C., and Holmes, R. S. IRON SUPPLY AND INTERACTING FACTORS RELATED TO LIME-INDUCED CHLOROSIS. Soil Sci. 82: 507-519. 1956.

Available iron supply was determined in three soils and found to be an important factor relating the susceptibility of Wheatland milo, PI-54619-5-1, and Hawkeye soybeans to lime-induced chlorosis. These three plants were grown on calcareous Tripp, Quinlan, and Millville soils. Iron chlorosis developed in Wheatland milo and PI-soybeans on Tripp and Quinlan soils and in PI-soybeans on Millville soil. Hawkeye soybeans developed normally on all three soils.

Using inorganic, radioactive, and chelated iron, naturally available soil iron was found to be greater in Millville than Tripp or Quinlan soils.

PI-soybean and Wheatland milo showed the same response to increasing additions of inorganic iron when grown on solution cultures, but PI-soybeans absorbed chelated iron (Fe-DTPA) much more efficiently than milo. These soil and plant species differences are discussed with reference to the capacity of Millville soil to induce an iron chlorosis in PI-soybeans but not in Wheatland milo. Chlorosis was corrected in Wheatland milo by adding ferrous sulfate to Tripp and Quinlan soils.

Butler, P. C., and Bray, R. H. EFFECT OF THE ZINC CHELATE OF ETHYLENEDIAMINETETRAACETIC ACID ON PLANT UPTAKE OF ZINC AND OTHER HEAVY METALS. Soil Sci. Soc. Amer. Proc. 20: 348-351. 1956.

In a study of the effect of chelated zinc on plant composition, the addition of the zinc chelate of ethylenediaminetetraacetic acid (EDTA) to the soil at planting time gave results varying with the clay content of the soil. Both zinc and copper increased in the plants grown on a sandy soil. Manganese and iron contents were unaffected. No increase in zinc or copper contents of the plants occurred on a heavy silt loam soil, although as high as 50 ppm. of zinc was added. The added zinc disappeared from the water soluble and exchangeable forms in the latter but some buildup of exchangeable zinc occurred in the sandy soil. A large proportion of the added zinc was recovered by acid extraction. Laboratory studies indicated that the heavy soil rapidly takes the zinc away from the EDTA.

Chang, S. C., and Jackson, M. L. SOLUBILITY PRODUCT OF IRON PHOSPHATE. Soil Sci. Soc. Amer. Proc. 21: 265-269. 1957.

The solubility product of iron phosphate was determined by both dissolution and precipitation methods in dilute salt solutions. Solution pH values slightly below the determined isoelectric pH of 2.75 for iron phosphate were employed to get determinable amounts of iron in the solution. The pK_{sp} value was calculated from the ionic activities of Fe^{3+} and H_2PO_4- in the equilibrium solution by the following equation,

$$pK_{sp} = pFe^{3+} + pH_2PO_4- + 2pOH-$$

which was found to coordinate the data most satisfactorily. The pK_{sp} value of iron phosphate increased with a 1000-fold decrease of the solid-to-solution ratio from 33.6 to 35.1. It increased from 33.0 to 33.2 over a 50-fold decrease of the concentration of the precipitation reagents. A medial value of 33.5 was approached by the two procedures; however, for low iron phosphate-solution ratios, such as those commonly employed for soil extraction, the applicable pK_{sp} value agrees with the most dilute solid-solution value of 35 or more. Similarly for aluminum phosphate, the applicable pK_{sp} value extends as high as 32 for dilute suspensions. The variation in apparent solubility product with amount of solid per unit volume of solution is negligible compared to the magnitude of the pK_{sp} which is the reciprocal of a billion trillion trillion. The calculations from solubility products show that aluminum phosphate and iron phosphate should precipitate and accumulate even in neutral soils, as observed experimentally.

Danielson, R. E., and Russell, M. B. ION ABSORPTION BY CORN ROOTS AS INFLUENCED BY MOISTURE AND AERATION. Soil Sci. Soc. Amer. Proc. 21: 3-6. 1957.

Using short-term experiments, the uptake by corn seedlings of Rb^{86} from soil and from osmotic solutions was measured under various levels of moisture stress and oxygen pressure. Soil moisture tensions, up to 12 atm., were developed using pressure plate apparatus appropriate to the tensions desired, and the osmotic studies were conducted with a highly porous, expanded perlite material wetted with aqueous solutions of mannitol. Continuous flushing with gas mixtures of air and nitrogen was used to maintain the oxygen partial pressures desired.

Moisture stresses developed from soil moisture tensions and from osmotic solutions differed markedly in their effect on Rb^{86} absorption. The ion uptake decreased rapidly with initial increases in soil moisture tension and leveled out at higher tensions to give a curve nearly logarithmic in nature. Increasing osmotic pressure caused only a slight decrease in absorption of Rb^{86} by the corn seedlings. The ion uptake from soil was nearly a straight line function of moisture content.

Initial increases in oxygen concentration of the gaseous environment at each level of soil moisture tension or osmotic pressure resulted in increased uptake of Rb^{86}. In soil, however, the minimum oxygen content at which ion absorption reached a level value decreased with increasing soil moisture tension.

De Mumbrum, L. E., and Jackson, M. L. INFRARED ABSORPTION EVIDENCE ON EXCHANGE REACTION MECHANISM OF COPPER AND ZINC WITH LAYER SILICATE CLAYS AND PEAT. Soil Sci. Soc. Amer. Proc. 20: 334-337. 1956.

The degree to which cations which form weak bases are sorbed in excess of cations which form strong bases is shown to be about 10% in montmorillonite and 40% in peat. These excesses were accounted for by a special reaction mechanism which was revealed when layer silicate clays or peat fractions were examined by an infrared absorption technique. Copper and zinc saturation decreased the 2.8 micron hydroxyl absorption intensity of montmorillonite, vermiculite, and kaolinite, indicating a reaction with octahedral OH in the layer silicates. The larger peak of kaolinite at 2.7 microns was not affected. Also, the copper treatment yielded an additional pair of absorption peaks at 6.4 and 7.0 microns. Aluminum and iron treatment tended to increase the 2.8 micron peak slightly. Copper and zinc saturation of peat fractions resulted in numerous shifts in the double bond region of the spectrum, which were indicative of chelation with $C = O$ and $N = O$ groups.

El Ashkar, M. A., Bodman, G. B., and Peters, D. B. SODIUM HYPOSULPHITE-SOLUBLE IRON OXIDE AND WATER RETENTION BY SOILS. Soil Sci. Soc. Amer. Proc. 20: 352-356. 1956.

During the attempted explanation of differences in the water retention-extraction pressure curves of certain soils, estimates were made of their iron oxide content by the sodium hyposulphite method. The close relationship observed between iron oxide content and volume of water retained within the 1/10 < 15 atmosphere range led to examination with a larger group of soils, of the effect upon water retention of iron oxide removal.

Positive associations were found between content of iron oxide and of water retained (w) at both the 1/3 and 15 atmosphere pressures but the amount retained at 15 atmospheres increases more rapidly with increases in iron oxide content than does the 1/3 atmosphere water. The proportional amount of $(w_{1/3} - w_{15})$, expressed as a fraction of the $w_{1/3}$ water, therefore diminishes with increase of iron oxide. Removal of the iron oxide changes the situation, pronounced increases being brought about in the absolute and proportional percentages of $(w_{1/3} - w_{15})$.

Epstein, E. PASSIVE PERMEATION AND ACTIVE TRANSPORT OF IONS IN PLANT ROOTS. *Plant Phys. 30: 529-535. Nov. 1955.

Experiments are described demonstrating a passive and reversible permeation of barley root tissue by sulfate and other inorganic ions through diffusion. The volume so accessible (the "outer" space of the tissue), as measured with sulfate, has the following properties.

1) Its magnitude is approximately 23% of the volume of the tissue.
2) Migration of the ions into this space is freely reversible; upon transfer of the tissue to water, the ions diffuse out of the space again.
3) Equilibration with the ambient medium is reached in 60 minutes.
4) At equilibrium, the concentration of the ions in the "outer" space of the tissue equals their concentration in the ambient medium.
5) There is no competition among different ions for the space.
6) There is no pH effect. The space was freely accessible to selenate, phosphate, and calcium ions, in addition to sulfate.

The relation is examined between diffusion of ions in the "outer" space of the tissue and their absorption by the active ion transport mechanism, i. e., their transfer into the "inner" space. It is shown that the immediate substrate for absorption by the active mechanism is the solution in the "outer" space of the tissue, this solution in turn being in equilibrium with the ambient solution.

Garman, W. L. POTASSIUM RELEASE CHARACTERISTICS OF SEVERAL SOILS FROM OHIO AND NEW YORK. Soil Sci. Soc. Amer. Proc. 21: 52-58. 1957.

Seventeen Ohio surface soils, 25 New York surface soils, and 21 New York subsoils were investigated. Potassium release characteristics were determined by continuous cropping and by four different chemical methods. A continuous leaching method employing the use of 0.01 N HCl gave the highest correlations with continuous cropping. Cumulative amounts of potassium removed by this leaching technique were plotted to produce a family of curves with specific characteristics for each great soil group. A measure of the rate of release of K from structural positions is indicated by the slope of the line drawn between the points plotted from 5 to 10 liters of leachate.

Potassium release from both surface and subsoils followed the order of Brown Forest, Gray-Brown Podzolic, Brown Podzolic, and Podzol. The average K concentration in the last 5 liters (5 liters total) of leaching solution from surface soils was as follows: Brown Forest 0.31 ppm., Gray-Brown Podzolic 0.12 ppm., Brown Podzolic 0.05 ppm., and Podzol 0.04 ppm.

Hall, W. A. AN ANALYTICAL DERIVATION OF THE DARCY EQUATION. Amer. Geophys. Union Trans. 37: 185-188. 1956.

The Darcy equation is derived in general form for non-isotropic porous media from Newton's basic laws of motion and viscosity. The necessary and sufficient additional postulates are: (1) inertia forces of the system are negligible, (2) the liquid films are continuous, and (3) that a volume element of the fluid-porous medium system can be selected which is small compared to the gross dimension of the system yet large enough that the surface area of the matrix therein can be considered to be uniformly distributed throughout the volume element. The equation is shown to be valid for all saturated and non-saturated porous media systems which satisfy these postulates.

Jacob, W. C., and Klute, A. SAMPLING SOILS FOR PHYSICAL AND CHEMICAL PROPERTIES. Soil Sci. Soc. Amer. Proc. 20: 170-172. 1956.

A sampling study was made on soil characteristics from an organic matter experiment on Sassafras sandy loam soil on Long Island. The paper gives the components of variance for plots, samples, and determinations for several chemical and physical properties. The use of these components in determining a sampling program is illustrated for one physical property.

Jeyaseelan, K. N., and Matthews, B. C. CHEMICAL PROPERTIES OF SOUTHERN ONTARIO SOILS. Canad. Jour. Agri. Sci., Vol. 36, No. 5, pp. 394-400. Sept.-Oct. 1956.

Statistical analyses of chemical and physical data on 643 surface soil samples showed that (1) the variation in properties was greater between series than within a series and (2) the variation was greater between those within great soil groups. It was found that with variation in soil texture from sand to clay, there was an increase in the average cation exchange capacity, exchangeable potassium content, and organic matter content. It was concluded that a series such as the great soil group does in fact represent a discrete portion of the soil population, and it has meaning in terms of chemical and physical properties of the surface soils.

Jones, M. B., Pratt, P. F., and Martin, W. P. THE EFFECT OF HPAN AND IBMA ON THE FIXATION AND AVAILABILITY OF POTASSIUM IN SEVERAL OHIO SOILS. Soil Sci. Soc. Amer. Proc. 21: 95-98. 1957.

Solutions of K salts with and without conditioner were added to four soils in sufficient solution to bring the soils approximately to field capacity. The conditioners were HPAN (hydrolized polyacrylonitrile) and IBMA (isobutylene maleic acid). The treated soils were incubated for several days, oven-dried at 68° C., and K fixation against extraction with NH_4OAc was determined. The results indicated that K fixation was reduced by the conditioner treatments.

In a pot experiment, using corn and Sudangrass as assay plants, K was added at 2 levels with and without conditioner on 2 Ohio soils. High levels of N and P were added to all pots so that they would not be limiting factors. The yield and K content of corn and Sudan grass were greater on pots treated with conditioner and K than on pots treated with either alone. Possible explanations for the reduction in K fixation and greater availability of K resultant from treatment with conditioners are presented.

Kanehiro, Y., and Sherman, G. D. EFFECT OF DEHYDRATION-REHYDRATION ON CATION EXCHANGE CAPACITY OF HAWAIIAN SOILS. Soil Sci. Soc. Amer. Proc. 20: 341-344. 1956.

Dehydration, induced by extended sun-drying or by short periods in an oven at 105° C., reduced the cation exchange capacity of a soil. This reduction generally increased with the annual rainfall, being most pronounced in the wettest soils of the Islands. Furthermore, in a given profile of these extremely wet soils, this reduction increased with depth. This trend is culminated in a subsoil of a Hydrol Humic Latosol (307% moisture) which dropped in capacity value from 125.8 me./100 g. to 37.6 me./100 g. in 100 days of sun-dehydration.

Removal of natural vegetative cover in a virgin area caused a reduction of 16.8% in cation exchange capacity for the surface soil at the end of 10 months in a Humic Latosol. Also, in this same area comparative figures for the virgin and cultivated surface soils show that extended cultivation with subsequent susceptibility to dehydration has caused a loss of 27.8% of the cation exchange capacity of the soil.

Soils which are located in dominantly dry areas showed a seasonal effect on cation exchange capacity. Samples taken after a rainy season showed slightly higher values than those taken during a dry season in a given site.

Dehydrated soils increased significantly in cation exchange capacity upon rehydration in dry and moderately wet area soils. This display of reversibility was not evident in wet area soils.

Lunt, O. R., Hemaidan, N., and Wallace, A. REACTIONS OF SOME POLYAMINE POLYACETATE IRON CHELATES IN VARIOUS SOILS. Soil Sci. Soc. Amer. Proc. 20: 172-175. 1956.

The solution-solid phase distribution of Fe supplied as polyamine polyacetate chelates in several soils and clays at various pH levels was studied. In the pH range from 7 to 8, the disappearance of Fe from solution from clays and soils having moderate amounts or more of clays was much more rapid than is the loss of Fe from nutrient solutions in the same pH range. Clays apparently catalyze the hydrolysis reaction by which Fe is fixed in alkaline solutions. With a number of soils and clays, there was considerable loss of Fe from the soil solution under acid conditions. The process by which FeEDTA ethylenediaminetetraacetate is fixed in acid soils is obscure, although Fe and EDTA were removed from solution at about the same rate. The rates of reaction indicated that simple surface exchange was not involved. Movement of Fe chelates in fine textured soils is slow. Organic matter content, wetting and drying, microbiological activity, and nominal quantities of salts in soils did not affect the loss of Fe from solution greatly. The recovery of fixed chelated Fe by plants was poor as compared to soluble chelated iron.

Matthews, B. C., and Smith, J. A. A PERCOLATION METHOD FOR MEASURING POTASSIUM-SUPPLYING POWER OF SOILS. Canad. Jour. Agr. Sci. 37: 21-28. 1957.

An apparatus for continuous circulation through a soil sample and a cation exchange resin has been devised by modification of the Lees perfusion apparatus. The amount of exchangeable and non-exchangeable potassium released from the soil and adsorbed by the resin was found to correlate highly with the amount of potassium taken up by alfalfa grown continuously in the greenhouse (r = 0.91). The rate and amount of release differed for different soils and the rate of release showed little correlation with the original level of exchangeable potassium. It is suggested that the rate of release, i.e., potassium-supplying power, is a soil type characteristic and not a function of management or fertilization. The percolation method proposed will permit ready evaluation of the potassium-supplying power of Ontario soils.

McColloch, R. C., Bingham, F. T., and Aldrich, D. G. RELATION OF SOIL POTASSIUM AND MAGNESIUM TO MAGNESIUM NUTRITION OF CITRUS. Soil Sci. Soc. Amer. Proc. 21: 85-88. 1957.

Soil and leaf analyses were made in connection with six field experiments involving orange trees fertilized with potassium and/or magnesium. Experimental plots were located in 6 orchards in 4 southern California counties.

The conentration of magnesium in spring-cycle leaves was correlated with the degree of leaf symptoms characteristic of magnesium deficiency. Addition of magnesium fertilizer resulted in a marked increase in leaf magnesium and a disappearance of deficiency symptoms. Potassium fertilization accentuated magnesium deficiency. Deficiency symptoms were associated with leaf magnesium concentrations of 0.20% or less. The ratio of exchangeable K/Mg in the soil (particularly the 18- to 30-inch depth) was highly correlated with the percent magnesium in the leaves.

McLean, E. O., Adams, D., and Franklin, Jr., R. E. CATION EXCHANGE CAPACITIES OF PLANT ROOTS AS RELATED TO THEIR NITROGEN CONTENTS. Soil Sci. Soc. Amer. Proc. 20: 345-347. 1956.

This investigation included a total of 20 agronomic crops grown in gravel cultures to which 1/5 Hoagland solution was applied at regular intervals. In addition, six species were grown at three different nitrogen levels in the culture media, and one of the species was grown for two different lengths of time under the three nitrogen levels.

Results obtained indicate that there is a rather high correlation (R = 0.866) between the cation exchange capacities of plant roots and their percentages of nitrogen. In general, as more nitrogen was supplied to a given species of plant via the growth medium, an increase in percentage of nitrogen in the plant was obtained, accompanied by a corresponding increase in the cation exchange capacity of the plant roots.

Practical significance of the effect of nitrogen on the cation exchange capacity of plant roots would seem to be that through this mechanism all of the fertilizer and lime elements are interrelated in their effects on plant response. By affecting the exchange capacity of the roots, applications of nitrogen may thereby influence the recently recognized ability of plants to differentially compete with one another and with the soil for phosphate, potassium, calcium, and magnesium.

Nash, V. E., and Marshall, C. E. CATIONIC REACTIONS OF FELDSPAR SURFACES. Soil Sci. Soc. Amer. Proc. 21: 149-153. 1957.

The reactivity of finely divided feldspar particles in the presence of neutral salt and acidic solutions was studied. In the case of albite, evidence on surface stability in presence of dilute salts near neutrality is given. Microcline, albite, oligoclase, andesine, labradorite, bytownite and anorthite were converted to surface homionic systems in two ways and the bonding energies of the cations were determined. Large variations with lattice composition were found. Experiments on the entry and release of cations (Na, K, Ca, NH_4, Mg, and Sr) showed the apparent exchange capacity of the surface layer was a sensitive function of the ions concerned. At least two types of cationic bonding were indicated. The ammonium ion was found to be an extremely effective displacer, and after entry a large proportion of it was found to be fixed with a high bonding energy. It is concluded that under the conditions of these experiments, any poorly organized surface layer must be thin, that is not more than a very few unit cells in depth.

Nishita, H., Kowalewsky, B. W., Steen, A. J., and Larson, K. H. FIXATION AND EXTRACTABILITY OF FISSION PRODUCTS CONTAINING VARIOUS SOILS AND CLAYS: I. Sr90, Y91, Ru137, and Ce144. Soil Sci. 81(4): 317-326. April 1956.

Water-soluble, exchangeable, and nonexchangeable forms of long-lived and medium-lived fission products (Sr90, Y91, Ru106, Cs137, and Ce144) contaminating five soils and two clay minerals were studied by the use of leaching procedures. With few exceptions, the relative relationships of these fission products in the soils were:

Water-soluble fraction: Ru106>Sr90>Y91≥Ce144>Cs137
Exchangeable fraction: Sr90>CS137>Ru106≥Y91≥Ce144
Nonexchangeable fraction: Ce144, Y91>Ru106>Cs137>Sr90

Olsen, S. R., and Watanabe, F. S. A METHOD TO DETERMINE A PHOSPHORUS ADSORPTION MAXIMUM OF SOILS AS MEASURED BY THE LANGMUIR ISOTHERM. Soil Sci. Soc. Amer. Proc. 21: 144-149. 1957.

Adsorption of phosphorus by soils from dilute solutions showed a closer agreement with the Langmuir isotherm than with the Freundlich isotherm. Constants calculated from the Langmuir isotherm and interpretations based upon the meansing of these constants permit a sound theoretical approach to some of the problems of phosphorus retention in soils.

The adsorption maximum calculated from the Langmuir isotherm was closely correlated with the surface area of soils as measured by ethylene glycol retention. The correlation coefficients and regression equations were $r = 0.98$ and $y = 0.276x + 3.47$ for 10 alkaline soils, and $r = 0.96$ and $y = 0.641x + 5.73$ for 12 acid soils, where $y =$ mg. P per 100 g. soil and $x =$ mg. ethylene glycol retained per g. of soil. For a given surface area, i.e., 30 mg. glycol per g. soil, the acid soils held 2.17 times as much phosphorus as the alkaline soils.

The average values of a second constant, k, derived from the slope and intercept values, were 0.92 and 4.39 for the alkaline and acid soils, respectively. As the value of this constant increases, the bonding energy of the soil for phosphorus increases. Thus, the acid soils retained more phosphorus per unit of surface area and also held the phosphorus with a greater bonding energy than the alkaline soils.

Perkins, A. T., Dragsdorf, R. D., and Bhangoo, M. S. REACTIONS BETWEEN PHOSPHATES AND KAOLINITE DECOMPOSITION PRODUCTS. Soil Sci. Soc. Amer. Proc. 21: 154-157. 1957.

Kaolinite mixed with mono, di, or tribasic calcium phosphate or calcium carbonate was ball-milled in porcelain jars for periods of time up to 170 days. Changes in chemical reactions such as capacity to fix phosphates and the solubility of aluminum, calcium and magnesium were determined. pH values were recorded and identification of products produced by grinding was undertaken by use of X-ray and electron microscope techniques.

Correlations were found between phosphate fixation and increasing pH value, and phosphate fixation and solubility of aluminum. The addition of large amounts of the phosphate increased the rate of clay decomposition when the pH value was over 6.6. Tribasic phosphate caused a more rapid decomposition of the clay than did calcium carbonate when the pH values were in the same range. The fixation of phosphate by kaolinite is correlated with time of reaction, pH, amount of phosphate added and the amount of soluble Al_2O_3 (R_2O_3).

Shaw, W. M., and Veal, N. C. FLAME PHOTOMETRIC DETERMINATION OF EXCHANGEABLE CALCIUM AND MAGNESIUM IN SOILS. Soil Sci. Soc. Amer. Proc. 20: 328-333. 1956.

The Beckman Model DU spectrophotometer, with No. 9200 attachment, and No. 4300 photomultiplier assembly was used to determine exchangeable Ca and Mg in soils. The study involved an investigation of the instrumental adjustments that would give the highest metal-to-background emission ratio, including effect of flame composition. The effects of Al, Fe, Mn, and PO_4 upon Ca and Mg flame emissions were investigated. Thirty-two soils were analyzed chemically, and by 2 flame photometric procedures for Ca and Mg with special emphasis on the effects of method of extraction and preparation of test solution.

Soil Biology

Bollen, W. B., and Lu, K. C. EFFECT OF DOUGLAS-FIR SAWDUST MULCHES AND INCORPORATIONS ON SOIL MICROBIAL ACTIVITIES AND PLANT GROWTH. Soil Sci. Soc. Amer. Proc. 21: 35-41. 1957.

Sawdust and other wood wastes applied to soil may retard plant growth by inducing nitrogen deficiency but these effects with Douglas-fir are less pronounced than with many other residues of wide C:N ratio. While Douglas-fir wood is extremely low in nitrogen it is low also in available carbon. The predominating lignin-cellulose complex is resistant and only slowly metabolized, enabling a minimum amount of nitrogen, repartitioned among successive crops of microbes, to suffice for long-continued decomposition.

Sawdust showed no direct toxicity and had little effect on soil pH. Resins and other extractives were readily decomposed. Apparent decomposition percentages based on 50 days CO_2 production without added available nitrogen in soil respiration experiments were: for dextrose 60, wheat straw 48, red alder 40, ponderosa pine 33, western red cedar 33, Douglas-fir 30, pitch 30, western hemlock 27, bark 26, and lignin 6%, respectively. Although added nitrogen fertilizer hastened decomposition of organic matter having wide C:N ratio, it commonly depressed cumulative CO_2 evolution in soil respiration.

Greenhouse and field studies indicate that to avoid induced nitrogen deficiency 5 to 10 pounds of nitrogen per ton of sawdust are generally sufficient during the first year; nitrogen additions the following 2 or 3 years may be successively halved. Douglas-fir sawdust without added nitrogen often causes no retardation and in some cases significant increases of certain crops such as sunflowers and strawberries. Corn appeared much more sensitive to nitrogen deficiency. All wood wastes and cereal straws at 100 tons per acre have been found to depress plant growth unless nitrogen is added.

De, P. K., and Mandal, L. N. FIXATION OF NITROGEN BY ALGAE IN RICE SOIL. Soil Sci., Vol. 81, No. 6, pp. 453-458. June 1956.

The amount of nitrogen fixed by algae in six rice soils under waterlogged conditions were determined by weekly analyses of the gases in the soil atmosphere. In the cropped but unfertilized soils fixation varied from 13.8 to 44.4 pounds of nitrogen per acre. Application of superphosphate at the rate of 60 pounds of P_2O_5 per acre stimulated nitrogen fixation only in soils relatively poor in this nutrient. More than 80 percent of the fixation was shown to take place in the first 4 weeks after transplantation.

Erdman, L. W., and Means, U. M. STRAINS OF RHIZOBIA EFFECTIVE ON TRIFOLIUM AMBIGUUM. Agron. Jour. 48: 341-343. 1956.

Effective strains of rhizobia to inoculate Kura clover (Trifolium ambiguum) were isolated from nodules on T. spadiceum, T. ochroleucon and from nodules on T. ambiguum produced with enrichment cultures prepared with six different soil samples. These soils and the nodulated specimens were all from the same general locality in Turkey. In greenhouse sand cultures 21 strains gave yields which were significantly better than the uninoculated controls. In greenhouse soil cultures with five soils, an overall comparison of the uninoculated plants with the inoculated plants showed a highly significant increase in dry weight and nitrogen content brought about by the inoculation.

Martin, J. P., Klotz, L. J., DeWolfe, T. A., and Ervin, J. O. INFLUENCE OF SOME SOIL FUNGI ON GROWTH OF CITRUS SEEDLINGS. Soil Sci. 81(4): 259-267. April 1956.

A greenhouse study was made of the influence of common soil fungi separately and in various combinations on growth of sweet orange seedings in Yolo sandy loam and Holtville clay loam. Fumigation of the soil with propylene oxide, spreading to allow dissipation of the fumigant, and inoculation with spore suspensions of the desired fungi resulted in establishment in the soil of most of the fungus species tested. Once established, a particular species tended to resist establishment of other species for extended periods.

The study demonstrated that the fungus population of the soil can vary tremendously without significantly influencing growth of citrus seedlings. Most species tested exerted little or no influence on growth of citrus seedlings. Under the conditions of the investigation, Thielaviposis basicola, however, greatly reduced growth in two soils. When this organism was combined with other fungi, such as Penicillium nigricans or Stachybotrys atra, the reduction in growth was less, but with species such as Penicillium funiculosum or Trichoderma verdi, no influence on the reduction in growth rate due to T. basicola alone was evident.

Thielaviposis basicola caused strong iron-chlorosis leaf patterns on citrus seedlings in Holtville silty clay loam without changing the total iron content of the leaves.

Seay, W. A., and West, S. H. THE EFFECT OF SEED TREATMENT ON YIELD AND GERMINATION OF GARDEN PEAS. Soil Sci. Soc. Amer. Proc. 20: 198-200. 1956.

The effects of Spergon treatment and Rhizobium inoculation of five varieties of garden pea seed on the yield and germination of peas in the field and on germination of peas in soil at 40°, 45°, and 50° F. in the laboratory were investigated. Although there was a trend towards increased yield due to either Rhizobium or spergon treatment and the combination of both treatments gave somewhat better yields than either treatment alone, yield increases were not significant. Spergon treatment increased germination whereas Rhizobium inoculation did not affect germination. As the Maury soil employed evidently contained the correct rhizobia (non-inoculated plants were nodulated), the data presented shed no light on the question of inoculant compatibility with seed treatment.

Soil-plant-animal Relationships

Fisher, J. R., and Bradshaw, K. E. USES OF SOIL-VEGETATION SURVEY INFORMATION IN ROAD CONSTRUCTION. Soil Sci. Soc. Amer. Proc. 21: 115-117. 1956.

Engineers constructing roads in upland areas derive much information from soil-vegetation survey data. Soil series characterized as to their behavior for road construction enable the engineer to lay out roads that pass through the areas of better soils and avoid the difficult ones. Vegetation data guide the engineer in routing his road to mature timber stands. They show him what problems will be involved in clearing rights-of-way. Much more work must be done in testing laboratories to determine bearing ratios, optimum moisture percentages, swell percentages, and other characteristics for soil series.

However, field approximations of these data can be made, and these are all valuable aids to the engineer.

Gardner, R. A., and Wieslander, A. E. THE SOIL-VEGETATION SURVEY IN CALIFORNIA. Soil Sci. Soc. Amer. Proc. 21: 103-105. 1957.

This paper deals briefly with procedures and kinds of information currently being obtained in the soil-vegetation survey of wild land in California and some of the problems encountered. The principal objective of the survey is to obtain accurate basic information on the kind and distribution of soils and natural vegetation, their relationships, and their characteristics and uses as an aid in better management of wild lands. The classification and mapping of both soils and vegetation follows a closely integrated procedure in which the skillful stereoscopic interpretation of aerial photographs plays an important part.

Hyder, D. N., and Sneva, F. A. SEED- AND PLANT-SOIL RELATIONS AS AFFECTED BY SEEDBED FIRMNESS ON A SANDY LOAM RANGE LAND SOIL. Soil Sci. Soc. Amer. Proc. 20: 416-419. 1956.

Seed-soil and plant-soil relations were observed on a sandy loam soil given various mulching and firming treatments. Special emphasis was given to soil moisture trends.

The soil is sandy loam to a depth of about 12 inches where a semipermeable B horizon is found. Plant roots penetrate the B horizon and extend through the underlying layer of sand to a depth of 3 feet where a caliche hardpan is encountered.

Rolling to firm the seedbed provided advantages in moisture retention, rate of seedling emergence, seedling growth, survival, lateral root distribution, and the occurrence of root hairs near the surface. Heavy rolling above the seed was undesirable in terms of mechanical restriction to emergence, soil aeration, and subsequent restriction to germination under continued precipitation, number of primary roots, and lateral root distribution when cleavage lines were encountered.

A soil mulch above firm soil as obtained by rolling and shallow harrowing, and rolling in strips were especially beneficial in terms of moisture retention and grass survival.

Lazar, V. A., and Beeson, K. C. MINERAL NUTRIENTS IN NATIVE VEGETATION ON ATLANTIC COASTAL PLAIN SOIL TYPES. Agr. and Food Chem., Vol. 4, No. 5, p. 439, May 1956.

The classification of a soil type or any specified area of soil in terms of the nutritional quality of food or feed crops growing thereon requires the collection and analysis of a large number of samples because of the wide variation in the composition of plants growing under apparently uniform conditions. A study of the vegetation on five soil types in six areas of the Atlantic Coastal Plain showed that sampling leaves of the swamp blackgum, Nyssa sylvatica Marsh. var. biflora (Walt.), was an efficient method of estimating the cobalt, copper, manganese, and phosphorus status of native forage types in this region. For this purpose two samples of blackgum leaves were adequate for grouping soils with respect to the mineral nutrients, cobalt and copper. The cobalt content of the soil was not a sufficiently sensitive estimation of that in the plant to permit it to be used to estimate the cobalt concentration in the vegetation.

Nelson, R. E., Bradshaw, K. E., and Wieslander, A. E. PHOTO INTERPRETATION OF VEGETATION AND SOILS IN WILD LAND AREAS OF CALIFORNIA. Soil Sci. Soc. Amer. Proc. 21: 106-108. 1957.

Through stereoscopic study of aerial photographs many features of the vegetation and also ground features can be directly identified. This has a practical application in mapping vegetation and soils in upland areas of California. This paper describes how vegetation types can be identified by analysis of the features visible on aerial photographs. It then describes how soil mapping is facilitated by photo interpretation of ground features, land form, and vegetation.

Rust, R. H., and Odell, R. T. METHODS USED IN EVALUATING THE PRODUCTIVITY OF SOME ILLINOIS SOILS. Soil Sci. Soc. Amer. Proc. 21: 171-175. 1957.

Multiple curvilinear regression analyses of crop yields on major Illinois soil types and associations under different weather conditions and systems of management were made with the aid of an electronic digital computer.

The independent variables studied in relation to corn yield were: rainfall and the mean of daily maximum temperatures for the period July 1 to August 31; nitrogen applied in the current year and in the previous year; pounds of P_2O_5 and K_2O applied in the current year plus an estimate of carry-over; an index of the kind and frequency with which legume and legume-grass mixtures were grown preceding the crop; and year. Yield estimates for a 10-year period ending in 1955 on 7 representative soil types and associations are presented, together with measures of the reliability of the yield estimates.

The amount of yield variation explained by the regression equations varied from about 18 to 56% in the examples presented.

The primary objective of this study is to determine the relative productivity of major Illinois soils. The results presented are more satisfactory for this purpose than for predicting the net effect of individual management factors on crop yields.

For the kind of sampling and analysis employed in this study, data are needed for approximately 100 to 200 fields in order to make reasonably accurate estimates of crop yields for a soil type or an association of two closely related soils under various climatic conditions and management practices.

Soil Genesis, Formation, Classification and Mapping

Caldwell, R. E., and White, J. L. A STUDY OF THE ORIGIN AND DISTRIBUTION OF LOESS IN SOUTHERN INDIANA. Soil Sci. Soc. Amer. Proc. 20: 258-263. 1956.

Soil profile studies were made along two traverses extending from the Wabash River in a southeasterly direction across southern Indiana for the purpose of determining the distribution of loess in this area. The variation in thickness of the loess mantle with distance from the Wabash River, the assumed source, was measured, and equations of the curves showing the relationship were calculated. X-ray diffraction studies were made of the medium and fine silt fractions of the A_2 horizon of 10 profiles along the southern traverse. The ratio of the quartz/feldspar intensities was determined using sodium fluoride as an internal standard. The calcium, sodium, and potassium content of the medium silt fractions of these 10 horizons was determined by flame photometry. The equation for the curve fitted to points plotted along the northern traverse was $Y = 122 - 47 \log X$, where Y is the depth of the loess in inches and X is the distance from the Wabash River in miles. The equation for the southern traverse was $Y = 125 - 53 \log X$. The X-ray diffraction studies indicate that the quartz/feldspar ratio may be used as an index of weathering. The correlation coefficients for the relationship between the quartz/feldspar ratio may be used as an index of weathering. The correlation coefficients for the relationship between the quartz/feldspar ratio and distance from the Wabash River were 0.95 and 0.96 for the medium and fine silts, respectively. The results of the chemical determinations substantiated the findings of the X-ray diffraction studies. It is concluded that loess was transported across southern Indiana for a distance of about 90 miles.

Carlisle, F. J., Knox, E. G., and Grossman, R. B. FRAGIPAN HORIZONS IN NEW YORK SOILS: I. GENERAL CHARACTERISTICS AND DISTRIBUTION. Soil Sci. Soc. Amer. Proc. 21: 320-321. 1957.

Fragipans are dense, brittle subsoil horizons and appear to be indurated when dry, but the apparent induration disappears upon moistening. They are genetic soil horizons that have developed from many different parent materials. Fragipans have a wide geographic distribution, and they have been found below A-B horizon sequences characteristic of several great soil groups, and as a component of Low Humic Gley profiles. Properties of fragipans are closely related to texture of the soil material and the natural drainage of the soil. Fragipans are generally less permeable to water than the horizons above or below. Root penetration into these pans is very limited.

Carthew, A. R. USE OF PIPERIDINE SATURATION IN THE IDENTIFICATION OF CLAY MINERALS BY DIFFERENTIAL THERMAL ANALYSIS. Soil Sci. 80(5): 337-347. Nov. 1955.

The exothermic combustion peaks on the thermal curves given by piperidine-saturated montmorillonite, montronite, and illite differ in intensities and peak temperatures for each mineral. Montmorillonite and montronite give peaks of relatively high intensity, whereas illite gives peaks of low intensity. Kaolinite gives very little effect.

Krumbein, W. C., and Lieblein, J. GEOLOGICAL APPLICATION OF EXTREME-VALUE METHODS TO INTERPRETATION OF COBBLES AND BOULDERS IN GRAVEL DEPOSITS. Amer. Geophys. Union Trans. 37: 313-319. 1956.

Unusually large cobbles or boulders are sometimes observed in gravel deposits. Their occurrence raises the question whether individuals of such size may be considered as part of the pebble population or as 'erratics' transported by ice or other means. Large cobbles or boulders normally present in fluvial gravels presumably are related to competence of the transporting stream. This paper presents data on Brandywine (Pliocene?) gravel in Maryland, believed to be of fluvial origin. The largest cobbles in subsamples of fixed size were measured and arranged into an extreme-value distribution. Extreme-value theory provides a basis for estimating the likelihood of occurrence of large indivduals in a given group. The fit is satisfactory in terms of conventional limits, and leads to the belief that all large particles observed in the deposit are normal members of the stream-pebble population. The study therefore suggests that extreme-value methods may be applicable to other sedimentary problems. Some necessary mathematical details of the theory for such applications are given in the Appendix.

Ruhe, R. V., and Scholtes, W. H. AGES AND DEVELOPMENT OF SOIL LANDSCAPES IN RELATION TO CLIMATIC AND VEGETATIONAL CHANGES IN IOWA. Soil Sci. Soc. Amer. Proc. 20: 264-273. 1956.

Radiocarbon dates in Iowa indicate that specific upland soil landscapes can be referred to age ranges before present of: (1)>25,000 years, (2) 16,000 to 24,000 years, (3) 14,000 to 16,000 years, (4) 12,000 to 13,500 years, and (5)<11,000 years.

Paleofloras associated with the radiocarbon horizons as well as fossil pollen sequences of geologically correlative peats permit inferences regarding the vegetative and climatic environments relative to time of the specific upland soil landscapes. In late Sangamon time (>25,000 years) the soil landscapes were dominantly forested under a cool, moist climate. Forest dominated the landscape during Wisconsin time (24,000 to 11,000 years) under cold, moist glacial climatic regimes and cool, moist intraglacial intervals. A warmer grassland environment may have occurred in mid-Wisconsin time (15,000 to 13,500 years). A cool, moist, arboreal environment may have culminated approximately 5,000 years ago. A warmer, subhumid to humid prairie environment became dominant at that time. Such complex climatic and vegetative histories of soil landscapes relative to time should be considered in soil-genesis studies in Iowa as well as in other similar areas.

Stephens, C. G. A MANUAL OF AUSTRALIAN SOILS. Commonwealth Scientific and Industrial Research Organization, Australia, Melbourne. 1953.

An essential prerequisite for efficient action by any of the scientific and State organizations is the ability to recognize the different categories of soils. This manual provides a brief introductory account of the system of soil classification in use in Australia before 1925, an elementary outline of the modern system of classifying soils on the basis of their morphology, and a classification of Australian soils. Color photographs and morphological descriptions of the profiles of Australian representatives of the great soil groups are designed to facilitate the recognition of individual soils. A selected bibliography of modern Australian soil surveys and related investigations is included.

Tamura, Tsuneo. PHYSICAL, CHEMICAL, AND MINERALOGICAL PROPERTIES OF BROWN PODZOLIC SOILS IN SOUTHERN NEW ENGLAND: PAXTON AND MERRIMAC SERIES. Soil Sci. 81(4): 287-299. April 1956.

The mechanical analysis of two soils from Connecticut showed relatively low clay content (approximately 5 percent). The particle size distribution of the profiles was related to the presence of fragipan. The elemental composition was marked by increases in silica, potassium, and magnesium with depth; alumina decreased with depth in the Paxton soil, but reached a maximum in the B_{22} horizon in the Merrimac soil.

The mineralogical determination of the Paxton soil showed illite and vermiculite to be the chief components in the <19-inch depth: interstratified illite-vermiculite was most abundant below 19 inches. Small quantities of gibbsite were identified above 19 inches.

Both soils contained vermiculite, which was high in aluminum saturation; it is possible that the aluminous condition of these soils is responsible for much of the phosphate deficiency and aluminum toxicity found in crops grown in them. It is possible that the low clay content encountered in brown podzolic soils is caused by the dealuminination reaction, which would foster clay decomposition.

Thorp, J., Strong, L. E., and Gamble, E. EXPERIMENTS IN SOIL GENESIS--THE ROLE OF LEACHING. Soil Sci. Soc. Amer. Proc. 21: 99-102. 1957.

As a part of our study of the processes contributing to the formation of soils from glacial deposits we have examined the chemical and physical changes produced by organic acids and water-soluble materials found in leaves. Our laboratory procedure used columns of Miami B_2 soil through which various solutions were passed intermittently. These solutions flowed through the columns and were then collected at intervals and analyzed. Appreciable quantities of calcium, magnesium, iron, and manganese were mobilized in this way. In addition we found detectable amounts of fine silicate clays moving in suspension. Evidence for redeposition of iron compounds within the soil columns was found as well as the formation of "colloidal" films holding the originally discrete soil particles together. Colored bands which appeared in the columns were suggestive of soil horizons found in the field, particularly among the Podzolic soils.

Whiteside, E. P., Schneider, I. F., and Cook, R. L. SOILS OF MICHIGAN. Mich. State Univ. Agr. Expt. Sta. Spec. Bul. 402. Jan. 1956.

This bulletin is divided into three parts. Parts I and III attempt to define soil, to point out the different kinds of soil in Michigan, to explain why soil differences are important in land use and to show the location of the different kinds of soil in the State. The properties of soil that are commonly used in soil classification and mapping are discussed in Part II.

HYDROLOGY

General

Chilingar, G. V. SOVIET METHODS OF REPORTING AND DISPLAYING RESULTS OF CHEMICAL ANALYSES OF NATURAL WATERS AND METHODS OF RECOGNIZING OIL-FIELD WATERS: A SUMMARY. Amer. Geophys. Union Trans. 38: 219-221. 1957.

Several Soviet methods of reporting and displaying results of chemical analyses of natural waters are briefly outlined. In addition, some methods of studying waters from petroliferous formations are presented. A certain relationship may exist between the chemical composition of oil-field waters and the stratigraphic depth. The relationship between the total mineralization and the chemical composition of waters from the same stratum can be clearly shown graphically.

Clark, W. E. FORECASTING THE DRY-WEATHER FLOW OF POND CREEK, OKLAHOMA; A PROGRESS REPORT. Amer. Geophys. Union Trans. 442-450. 1956.

Pond Creek in west-central Oklahoma drains an area of 319 sq. mi. above the gaging station near Fort Cobb, Caddo County. Ground water, contained in the Permian Rush Springs sandstone under water-table conditions, moves toward the creek at an almost unchanging rate. The discharge of ground water into the creek as dry-weather flow is modified by evapotranspiration and antecedent overland runoff. Multiple correlations have been computed relating the dry-weather flow to the water level in a well and to a factor indicative of the rate of evapotranspiration. A method for forecasting the factor indicative of evapotranspiration and one for forecasting the water level in the well during dry weather are given; the result is a method for forecasting the dry-weather flow of the Creek. Forecasts of dry-weather flow for seven and 21 days compare favorably with observed flows. The technique may be utilized to extend a forecast for several months.

Gardner, W. H., and Hsieh, J. C. WATER VELOCITY IN UNSATURATED POROUS MATERIALS. Soil Sci. Soc. Amer. Proc. 20: 157-161. 1956.

Rate of flow of moisture in unsaturated porous materials at constant temperature depends upon the gradient of the moisture potential, the size of the flow channel, and other factors relating to the fluid and porous medium, but which may be held constant. Size of the flow channel likewise is continually changing. An experimental technique has been devised for direct measurement of the velocity of water movement in materials simulating soils. From these data, with the aid of moisture density measurments, rate of flow can be obtained.

Hubley, R. C. AN ANALYSIS OF SURFACE ENERGY DURING THE ABLATION SEASON ON LEMON CREEK GLACIER, ALASKA. Amer. Geophys. Union Trans. 38: 68-85. 1957.

The purpose of the present study has been to perform an empirical investigation of the energy transfer at an isothermal, melting snow surface and its relationship to observed meteorological parameters, using more refined instrumentation and methods of observation than were available in earlier, similar investigations by H. U. Sverdrup and C. C. Wallen.

The thickness of the surface layer of snow through which absorption of solar radiation occurs is determined from measurements of intensities of visible radiation within the snow. Albedo values for the snow are computed from measurements of incoming and reflected solar radiation over the snow surface. The snow albedo is found to vary with solar altitude and cloudiness as well as with changes in physical characteristics of the snow. When long-wave radiation is considered along with solar radiation, it is found that during the ablation season, the diurnal net transfer of radiant energy to the melting snowpack is often greater when skies are overcast than when skies are clear. A comparison is made between the radiative energy transfer at the surface of a model glacier in the Juneau Ice Field, and a model glacier in the Alps.

It is shown that energy transfer to the snow by rain falling on an isothermal melting snowpack is an insignificant part of the total energy transfer.

From measured and calculated values of net energy transfer at the snow surface, energy transfer by radiation, and energy transfer by rain, values of energy transfer by turbulence are determined for a series of selected observation periods. These values are used to calculate exchange coefficients. It is shown that by making a slight modification in the functional expression for heat transfer by turbulence from that used by Sverdrup and Wallen, it is possible to obtain a nearly invariant relationship between the heat transfer by turbulence, windspeed, and the vertical temperature distribution above the surface when an inversion is present.

It is found that turbulent transfer of heat is the most important factor in causing ablation on the Lemon Creek Glacier. This turbulent transfer of energy becomes very large during summer storm periods. As a result, the number of warm storms passing over the glacier in a single ablation season can largely determine whether the glacier will end the season with a positive or negative mass budget.

Huff, F. A., and Neill, J. C. AREAL REPRESENTATIVENESS OF POINT RAINFALL. Amer. Geophys. Union Trans. 38: 341-345. 1957.

Shower-type rainfall data collected on several Illinois raingage networks, ranging in area from 19 ac to 400 sq. mi., have been used to determine the areal representativeness of point rainfall measurements. Point rainfall was measured at the center of each area, and empirical relations for average and standard errors were developed for storm, weekly, and monthly periods. In addition, storm data for areas of 10 to 100 sq. mi. were used to obtain empirical relations between point and areal mean rainfall, when the point rainfall is measured at a gage displaced from the areal center by various distances. The results are considered representative of the Midwest and of other areas having similar climate and topography.

Johnson, C. E. UTILIZING THE DECOMPOSITION OF ORGANIC RESIDUES TO INCREASE INFILTRATION RATES IN WATER SPREADING. Amer. Geophys. Union Trans. 38: 326-332.. 1957.

Decomposition rates were determined for several plant residues which were incubated under controlled conditions in the absence of soil. Three of these plant residues, having a range in decomposition rate from high to low, were mixed with soil, and incubated. The decomposition rates in the absence of soil were similar to those obtained when the plant residues were mixed with soil. Microbial counts made during the decomposition of the plant residues in soil showed that the greatest number of microorganisms occurred in the soils containing plant residues which decompose rapidly. Ammonium nitrate applied to the soil mixed with plant residue stimulated decomposition slightly. Percolation rates of soil mixed with organic residues varied with the amount of material applied, decomposition rate of the material, and the length of the incubation period. These studies indicate that initial decomposition at a moisture content near field capacity followed by decomposition at saturation may produce the highest infiltration rate for a given amount of organic residue. Infiltration rates on 0.005-acre test ponds containing vegetative cover or treated with cotton gin trash and alfalfa hay are presented. The use of organic residues to increase the infiltration rate of water-spreading areas is discussed.

Moran, P. A. P. THE STATISTICAL TREATMENT OF FLOOD FLOWS. Amer. Geophys. Union Trans. 38: 519-523. 1957.

The estimation of return periods of floods is considered from the point of view of mathematical statistics. This requires, essentially, the estimation of the tail of a probability distribution from a sample of values which is usually not dense in this tail. The error in the estimation of a flood corresponding to a given probability arises from two sources: (1) the uncertainty as to the mathematical form of the distribution; (2) the uncertainty arising from the statistical errors of estimation of the parameters of the distribution which occur because of the finiteness of the length of record. These errors are illustrated on a numerical example by fitting a log-normal distribution and a type III distribution to fifty annual values of extreme monthly flow of the River Murray.

Morisawa, M. ACCURACY OF DETERMINATION OF STREAM LENGTHS FROM TOPOGRAPHIC MAPS. Amer. Geophys. Union Trans. 38: 86-88. 1957.

Two methods are used to measure stream lengths from topographic maps: (1) using streams printed in blue, or (2) inserting streams into the drainage net wherever there are V-shaped contours. The accuracy of these two methods was tested by comparing measurements taken from maps with the streams as measured in the field.

In basins with area less than one half square mile, a paired *t*-test between field measurements and the contour method showed no significant difference while a paired *t*-test between field measurements and streams marked in blue did show a significant difference. In basins with area varying from 0.5 to 2.68 sq. mi., total stream lengths and drainage densities obtained using streams in blue are always smaller than those obtained by field measurement. This indicates that a significant difference exists. A paired t-test showed no significant difference between values of field measurement and the contour method.

This statistical study indicates that, at least in very small watersheds, streams should not be measured from topographic maps using the streams printed in blue. The contour method may be used.

Poland, J. F., and Davis, G. H. SUBSIDENCE OF THE LAND SURFACE IN THE TULARE-WASCO (DELANO) AND LOS BANOS-KETTLEMAN CITY AREA, SAN JOAQUIN VALLEY, CALIFORNIA. Amer. Geophys. Union Trans. 37: 287-296. 1956.

Releveling of bench marks in 1953 and 1954 by the U. S. Coast and Geodetic Survey indicates that subsidence of the land surface has now exceeded ten feet in two areas of the San Joaquin Valley. In the Tulare-Wasco (or Delano) area of Tulare County, subsidence which was as much as five feet in 1940 now has about doubled. The maximum rate of subsidence in recent years has been about 0.8 foot a year. In the Los Banos-Kettleman City area of western Fresno County, major subsidence extends from Ora Loma on the north beyond Huron on the south, a distance of 70 miles or more. The maximum rate there approaches one foot a year. Plots of subsidence against decline in artesian pressure suggest that pressure decline is a major cause of the subsidence. Compaction of the soil after irrigation is known to have caused substantial local subsidence in the Los Banos-Kettleman City area, and tectonic adjustment and other causes also may have contributed to the subsidence.

Potter, W. D. THE EFFECT OF NONREPRESENTATIVE SAMPLING ON LINEAR REGRESSIONS AS APPLIED TO RUNOFF. Amer. Geophys. Union Trans. 38: 333-340. 1957.

Relations between peak rates of runoff and four rainfall and topographic indices are determined by linear multiple regressions for eight samples of gaged watersheds in the Allegheny-Cumberland Plateau. Three of these samples are representative and five are nonrepresentative as to watershed location and size. Precision of the eight regression equations in estimating peak rates of runoff is shown to be materially affected by the representativeness of the sample from which the equation was derived, decreasing rapidly as the degree of sample nonrepresentativeness is increased. It is concluded that the precision of such an equation as an estimator depends more on the representativeness of the sample than it does on the sample size.

Robinson, A. R. PARSHALL MEASURING FLUMES OF SMALL SIZES. Colo. Agr. and Mech. College Agr. Expt. Sta. Tech. Bull. 61. Jan. 1957.

Small flumes have been found to give accurate measurements of discharge for both free-flow and submerged-flow conditions.

The usable range of capacity ranges from 0.005 to 0.15 cubic foot per second for a 1-inch flume; 0.01 to 0.30 for a 2-inch flume; and 0.03 to 0.60 for a 3-inch flume.

The flumes must be constructed to reasonably close tolerance in order to insure that the standard rating table may be used. The accuracy of the measurements depends to a large extent on the care exercised in the gage installation and reading.

When the flumes are to be operated only under free-flow conditions, the diverging section may be eliminated without changing the head-discharge relationship.

Rowe, P. B., and Colman, E. A. USES OF SOIL-VEGETATION SURVEY INFORMATION IN WATERSHED MANAGEMENT. Soil Sci. Soc. Amer. Proc. 21: 112-114. 1957.

Managing land for purposes of flood and erosion control and for maximum yield of usable water requires, among other things, knowledge of the hydrologic properties of soil in particular areas. Such knowledge can be obtained in the course of soil-vegetation surveys if the surveys are planned to provide the needed kinds of information. This paper discusses the kinds of information required, and points out the need for improved methods of measuring the hydrologic characteristics of soils. In addition, it describes the hydrologic properties of three wild land soils in Mendocino County, California, and interprets these properties in terms of some of their watershed management implications.

Tanner, William F. PARALLEL SLOPE RETREAT IN HUMID CLIMATE. Canad. Jour. Agr. Sci. 37: 605-607. 1956.

Three different statistical tests are applied to slopes on relatively uniform lithologies in northern Alabama. The tests applied are: Student's t, the correlation coefficient r, and analysis of variance. One hundred forty-five slope measurements were available for study. The following conclusions are drawn for the study area: (1) streams in V-shaped valleys are flanked by convex-upward slopes; (2) slopes above pediments, valley strips, or floodplains are lower than the slopes above actively downcutting streams; and (3) slopes above pediments, valley strips, or floodplains retreat at essentially constant angles. All three statistical tests yield the same results.

Todd, D. K., and Lau, Leung-Ku. ON ESTIMATING STREAMFLOW INTO A TIDAL ESTUARY. Amer. Geophys. Union Trans. 37: 468-473. 1957.

Because standard stream-gaging methods cannot be applied to measure streamflow in a tidal estuary where currents reverse direction with each tidal cycle, other methods are required. Continuous velocity traverses across a section are satisfactory, but this method is laborious and costly. A method for estimating streamflow is described based upon continuous salinity recorder data, tidal data, and current tables. These data, combined with particular correction factors to make the information applicable to an entire channel cross-section, permit streamflow estimates to be prepared rapidly. To illustrate the procedure, streamflows from the Sacramento-San Joaquin Valley, California, entering San Francisco Bay are computed. Errors, applications, and limitation of the method are discussed.

Wilcox, J. C., Holland, W. D., and McDougald, J. M. RELATION OF ELEVATION OF A MOUNTAIN STREAM TO REACTION AND SALT CONTENT OF WATER AND SOIL. Canad. Jour. Agr. Sci. 37: 11-20. 1957.

Water samples were obtained from a number of mountain lakes and irrigation reservoirs in the Okanagan Valley, and from streams emptying them. It was found that in any one drainage basin, the water had a higher pH and salt content at low elevation than at high elevation.

A more detailed investigation was conducted in the Mission Creek watershed. With decreasing elevation the following relationships were found: (a) increasing pH, electrical conductivity, and contents of calcium, potassium and sodium in the stream water; (b) increasing pH and conductivity in seepage water; (c) increasing pH and conductivity in the soil. Relationships between elevation and pH were similar with stream water, seepage water and soil, as also were relationships between elevation and conductivity values.

Chappelear, J. E. AN INVESTIGATION OF THE SOLITARY WAVE. Amer. Geophys. Union Trans. 37: 726-734. 1956.

Two solutions are presented to the problem of calculating the velocity field within a solitary wave and its celerity and profile, given its height and the depth of water in which it propagates. The first is analytic and approximate and may be regarded as a continuation of the calculations by J. Boussinesq and Lord Rayleigh. The second solution is numerical and is a type of iterative procedure which is necessary to take into account the nonlinear boundary condition which must be imposed on the solution (Bernoulli's theorem). No attempt is made to establish convergence of the iteration procedure, but if convergence is assumed, the method seems to be as accurate as the calculator wishes it to be. The results of the two solutions are compared with experimental results, and it is found that the second method of solution yields results for the velocity components which agree, on the whole, better with the experimental results.

Fishel, V. C. LONG-TERM TRENDS OF GROUND-WATER LEVELS IN THE UNITED STATES. Amer. Geophys. Union Trans. 37: 429-435. 1956.

Ground-water levels at the end of 1954 were at or near record-low stages throughout most of the southern two-thirds of the United States. These low stages, like those of the early 1930's, have led to frequent expression of the opinion that the water table throughout the country is continuously falling and that we are gradually exhausting our ground-water supplies. A good record of changes in ground-water levels is being obtained by the United States Geological Survey and cooperating State agencies from periodical measurements of water levels in nearly 20,000 observation wells. The records of some of these wells extend back 50 years. Many records are available for the period beginning in 1934. These long-term records indicate that in some areas the ground-water supply is overdeveloped. In the great majority of areas, however, the stage of the water levels correlates with the precipitation. Much of the country has been in drought and the water levels are at a low stage. As the precipitation increases, as it is bound to do later, the water levels will return to higher stages.

Hall, W. A. PERCHED WATER TABLES UNDER AN ARTIFICIAL GROUND-WATER RECHARGE SYSTEM. Amer. Geophys. Union Trans. 38: 346-348. 1957.

Hydrostatic pressure measurements were made at fourteen depths below the surface of a large ground-water recharge system. These measurements show the nature of the growth of the perched water tables resulting from the spreading operation. They demonstrate the importance of knowing subsurface stratigraphy for a considerable depth on the value to be derived from treatment of the surface soil to improve permeability. These factors also limit the potential capacity of a recharge area.

Hall, W. A. PERMEABILITY AND INFILTRATION RELATIONSHIPS IN ONE DIMENSIONAL INFILTRATION IN A UNIFORM SOIL. ~~Canad. Jour. Agr. Sci.~~ 37: 602-604. 1956.
Amer. Geophy. Union Trans

Equations are developed for the relationship between infiltration rate and time for one dimensional flow in a uniform soil of constant permeability. The depth of ponded water, the permeability of the soil and the moisture deficit in the transmission zone are the principal parameters. The equations are compared with experimental data with reasonably satisfactory results in view of the restrictive hypotheses.

Hall, W. A., Hagan, R. M., and Axtell, J. D. RECHARGING GROUND WATER BY IRRIGATION. Agr. Eng. 38: 98-100. 1957.

The experiment indicates the feasibility of replenishment irrigation of three-year old alfalfa subject to certain restrictions. Water should not be applied too late in the spring. Sufficient fall growth should be allowed before the irrigation is begun to permit the tops of the plants to remain above water. No conclusions may be drawn concerning effects of perched water tables in the root zone. Subject to these conditions, a considerable volume of water can be returned to underground storage by this method. By-products are the excellent control of weeds and the resulting improved quality of hay.

Merriam, Carroll F. POTENTIAL VALUE OF GROUND-WATER DATA. Amer. Geophys. Union Trans. 37: 463-467. 1957.

Programs of observation of the natural fluctuations of ground water covering an extensive area where there is no continuous aquifer are discouraging for the reason that readings must be made for a considerable period of time before they begin to have meaning. The results are not directly translated into quantitative data in the manner that streamflow records are. Consequently to appreciate the potential value of this work it is necessary to have some perspective of the possible future significance. Otherwise opportunities to gather much needed basic hydrologic data may be lost.

Papers by the same author describing the method of analysis and the practical application in forecasting assured river flow have appeared in previous Transactions of the American Geophysical Union. This paper deals primarily with the precautions believed to be essential in maintaining the high standard of consistency in order to make the effort expended on observation of greatest use in the future.

Rorabaugh, M. I. PREDICTION OF GROUND-WATER LEVELS ON BASIS OF RAINFALL AND TEMPERATURE CORRELATIONS. Amer. Geophys. Union Trans. 37: 436-441. 1956.

A method for predicting ground-water levels in the glacial-outwash deposits in the Ohio River valley near Louisville involves development of curves by graphical correlation to define the effects of winter precipitation and winter temperature on recharge to the water table, and to determine the decline of the water table as water leaks into the Ohio River. Recharge occurs in the winter when evaporation and transpiration are at a minimum and when the soil is at or near field capacity. Several months is required for the water to percolate through about 60 feet of alluvium to reach the water table.

Stallman, R. W. NUMERICAL ANALYSIS OF REGIONAL WATER LEVELS TO DEFINE AQUIFER HYDROLOGY. Amer. Geophys. Union Trans. 37: 451-460. 1956.

Two fundamental methods for studying aquifer hydrology are now in use. The first, applied many years ago, consists of detailed observation of aquifer inflow, outflow, and storage changes, and their variations in time. By analysis of these observations, estimates of the perennial recharge to the aquifer and other pertinent hydrologic data are obtained, all as gross characteristics of the aquifer. The need for greater detail gave rise to a second fundamental method: special field tests, such as pumping tests, by which the hydrologic coefficients could be measured in a comparatively short time. In order to evaluate properly the ability of an aquifer to serve as a source of perennial water supply, the geology and hydrology of the aquifer must be known in some detail over its entire area. The first method cannot supply the necessary detail in most cases, and the second method cannot ordinarily provide the needed areal coverage because of the lack of appropriate testing facilities. Thus an auxiliary third approach was sought which would combine the feature of a simple data-collection program with a final analysis yielding both adequate detail and areal coverage.

A method designed to satisfy these requirements is described. Water-level altitudes, usually observed in the course of more general ground-water studies, are analyzed by numerical methods, using finite-difference approximations of the basic differential equations which describe ground-water flow. Analytical methods are given for nonsteady flow through homogeneous and nonhomogeneous aquifers. Both direct and statistical solutions are shown. The hydrologic factors are computed as functions of transmissibility, and for the nonhomogeneous aquifer the variations of transmissibility in space are computed also from the water-level data. Knowledge of the absolute value of any one of the hydrologic factors at some location in the aquifer permits conversion of the computed functions to absolute terms for all the aquifer flow field studied.

Hydraulic Structures

Blaisdell, F. W., and Donnelly, C. A. HOOD INLET FOR CLOSED CONDUIT SPILLWAYS. Agr. Engin., Vol. 37, No. 10, pp. 670-672. Oct. 1956.

Surprising hydraulic characteristics are displayed by a hood inlet for closed conduit and highway culverts, formed of simple construction by cutting a pipe at an angle and attaching an anti-vortex wall. The slope of the conduit has no apparent effect on the spillway performance. The approach conditions and the pipe-wall thickness also have no detrimental effect on the performance. Scour may occur at the entrance, but the scour hole has moderate depth and extent, and scour can be prevented by paving the approach or by setting the invert above the erodible material.

SOIL AND WATER MANAGEMENT

General

MacGillivray, N. A., and Husbands, R. C. WATER MANAGEMENT AND ITS RELATIONSHIP TO MOSQUITO PRODUCTION IN IRRIGATED PASTURES. Proc. and Papers of the Twenty-fourth Annual Conf. of the Calif. Mosquito Control Assoc., 1956.

In general, seasonal irrigation efficiences are indicative of the degree of mosquito production on soils of moderate to low intake rate. However, particularly on those soils of moderate intake rate, irrigation efficiency as a measure of mosquito production should be applied with caution since it appears that the factor that contributes to the production of mosquitoes is the water management practices that are followed. It can be demonstrated that on moderate intake rate soils, low efficiencies can be obtained without mosquito production. It appears that a reduction in mosquito populations can be achieved through practices that result in high application efficiencies. The process of striving for higher efficiencies will tend to eliminate or reduce those practices that are conducive to mosquito production.

Day, Paul R. DISPERSION OF A MOVING SALT-WATER BOUNDARY ADVANCING THROUGH SATURATED SAND. Canad. Jour. Agr. Sci. 37: 595-601. 1956.

When salt water displaces fresh water in sand the boundary between the two liquid phases becomes diffuse after a short period of flow. The dispersion of salt may occur at a much greater rate than can be expected by ion diffusion. The effect has been attributed to a mechanism referred to here as hydrodynamic dispersion, a general phenomenon arising from the fact that the velocity of the moving stream varies from point to point in the porous system.

The mathematical treatment of the problem is based upon a statistical theory developed by Scheidegger. Equations have been derived here for the dispersion of salt water injected in the stream. The theory has been tested by displacing pure water with salt water in a colum of saturated sand and determining the concentration of effluent as a function of time. The measured concentrations vary with time in approximately the manner predicted by theory.

Carlson, C. A., Reinhart, K. G., and Horton, J. S. PREDICTING MOISTURE IN THE SURFACE FOOT OF SOIL. Soil Sci. Soc. Amer. Proc. 20: 412-415. 1956.

A method of predicting moisture content in the surface foot of soil has been developed by the U. S. Forest Service in cooperation with the Corps of Engineers, U. S. Army. By this method, moisture can be predicted for a given soil from the wettest to the driest condition that naturally occurs. In the development of the method, soil wetting and drying relationships were determined from detailed soil moisture and concurrent weather records. Wetting in the surface foot was found to depend primarily on the amount of rainfall and the amount of space available for storing water. Drying varied with the moisture level of the soil; it followed a characteristic curve for each season. Information needed for prediction--in addition to the wetting and drying relationships--includes the field maximum moisture content, transition dates for the seasonal depletion curves, and the size of the smallest storm which affects soil moisture. Records and prediction relations are being obtained for 146 experimental sites throughout the United States, Alaska, and Puerto Rico.

Jamison, V. C. PERTINENT FACTORS GOVERNING THE AVAILABILITY OF SOIL MOISTURE TO PLANTS. Soil Sci., Vol. 81, No. 6, pp. 459-471. June 1956.

Available moisture supply depends on plant and climatic as well as soil factors. Plant factors are drought resistance, rooting depth and ramification, plant vigor, and growth stage. Climatic factors are evaporation and transpiration losses as influenced by air temperature, air humidity, fog, wind, and sunlight. Soil factors are moisture tension relationships and osmotic pressure of the soil solutions; ions present in the soil solution and absorbed on the colloids; and soil moisture conductivity relationships, including the effect of wetting depth, soil temperature, and termperature gradients.

Singer, I. A., and Brown, R. M. THE ANNUAL VARIATIONS OF SUB-SOIL TEMPERATURES ABOUT A 600-FOOT CIRCLE. Amer. Geophys. Union Trans. 37: 743-748. 1956.

To assist engineers in the computations of thermal stresses, thermal loads, and the economic depth to which a protron synchrotron should be buried, the Meterology Group predicted the annual variations of sub-soil temperatures to the depth of 20 ft. Measurements were made at four stations having various types of ground cover, and located on a circle having a diameter of 600 ft. The analysis of one year of data showed that differences of ground cover have an appreciable effect on the temperature at all measuring depths. Standard thermal diffusion coefficients for a sandy soil are too small to account for the observed range of annual temperatures.

Fertilizers and Soil Fertility

Allison, F. E. ESTIMATING THE ABILITY OF SOILS TO SUPPLY NITROGEN. Agr. Chem., Apr. 1956.

Unless soils are distinctly acid, ammonia is considered an excellent source of available nitrogen. Crops in neutral soils may under certain conditions prefer ammonia to nitrate or grow best when both forms are available.

Anderson, A. J. MOLYBDENUM DEFICIENCIES IN LEGUMES IN AUSTRALIA. Soil Sci. 81(3): 173-182. Mar. 1956.

The evidence on the effects of various treatments on the molybdenum response shows that care must be taken to select the right conditions when testing for field responses of clover to molybdenum. In general, differences other than molybdenum need to be corrected, but the response may be prevented if nitrogen or lime is applied. Molybdenum deficiency does not occur in well-defined areas but is scattered in places throughout most of the areas where clover is being sown.

Armiger, W. H., and Fried, M. THE PLANT AVAILABILITY OF VARIOUS SOURCES OF PHOSPHATE ROCK. Soil Sci. Soc. Amer. Proc. 21: 183-188. 1957.

Greenhouse experiments were conducted with buckwheat and alfalfa in which 10 sources of phosphate rock were compared as agronomic sources of phosphorus. Tunisian rock gave the largest plant growth response and supplied more phosphorus than other rocks of either foreign or domestic origin. Of the domestic sources, South Carolina land rock and 1 of 2 Florida land pebbles rated highest. However, South Carolina land rock was consistently superior to the Florida pebble. Idaho rock was the only material that exhibited a low initial response pattern that improved with successive cuttings of alfalfa. Virginia apatite was not appreciably better than the check. Although Tennessee brown rock and Montana rock supplied some phosphorus to the plant, yield responses and phosphorus uptake from these materials were low.

There was a close correlation between laboratory evaluations of some phosphate rocks and their actual value as shown by plant growth response in greehouse tests. Ammonium citrate and citric-acid solubility tests seem to be equally efficient indexes for predicting the relative values of phosphate rocks as sources of phosphorus for plant growth. Both chemical and physical differences between materials afforded explanations for the differences in agronomic value. However, carbonate content of the rock seemed to be the most likely explanation for all rocks except the low fluorine curacao rock.

Bauwin, G. R., and Tyner, E. H. THE DISTRIBUTION OF NONEXTRACTABLE PHOSPHORUS IN SOME GRAY-BROWN PODZOLIC, BRUNIZEM, AND PLANOSOL SOIL PROFILES. Soil Sci. Soc. Amer. Proc. 21: 245-250. 1957.

Substantial amounts of phosphorus, which resists solution in conventional phosphorus fractionation solvents, are found in many soils. In this report, the insoluble phosphorus fraction is termed nonextractable phosphorus.

The distribution of nonextractable phosphorus in the horizons of four Illinois soil-type sequences developed on Peorian loess was studied. The relative proportion of the total soil phosphorus occurring in nonextractable form in the various soil horizons was B > A > C.

The very low content of nonextractable phosphorus found in the parent loessial C horizons, and the greater and variable nonextractable phosphorus contents found in the A and B horizons of soils developed on Peorian loess, suggested that the synthesis of nonextractable phosphorus forms in soils was related to weathering and soil development processes. No relation between degree of soil maturity and level of nonextractable phosphorus was apparent for the A horizons; however, a very significant increase in the nonextractable phosphorus content of the B horizons was found to occur with increasing soil maturity, particularly from the early through the medial stages of development. It was concluded that the accumulations of nonextractable phosphorus observed were associated with soil development processes.

Bentley, C. F., Gareau, L., Renner, R., and McElroy, L. W. FERTILIZERS AND NUTRITIVE VALUES OF HAYS. I. SULPHUR-DEFICIENT GREY WOODED SOILS. Canad. Jour. Agri. Sci., Vol. 36(5): 315-325. Sept.-Oct. 1956.

In sulphur-deficient grey wooded soils, fertilizers caused changes in the protein and mineral composition of legume hay, and affected nutritive values, besides producing yield increases of up to 500 percent. Where sulphur-supplying fertilizers were used, the sulphur content of the hay was usually increased and, in some cases, this was true of the protein content as well, even where no nitrogen was supplied with the sulphur. Rabbits fed forage from fertilized plots made faster gains than those fed feeds from unfertilized plots. Where feed efficiency was measured, it was lowest for hay from untreated areas. There were no consistent correlations between chemical composition of the feeds and the marked differences in their nutritive values as measured by rate and efficiency of rabbit gains.

Bernstein, L., and Pearson, G. A. INFLUENCE OF EXCHANGEABLE SODIUM ON THE YIELD AND CHEMICAL COMPOSITION OF PLANTS: I. GREEN BEANS, GARDEN BEETS, CLOVER, AND ALFALFA. Soil Sci. 82: 247-258. Sept. 1956.

Green beans, table beets, clover and alfalfa were grown on two soils of contrasting exchange capacities, treated with VAMA, and adjusted to five levels of exchangeable sodium. Yields were related to the exchangeable-sodium-percentages rather than to the absolute level of exchange-sodium. Comparison of yields in the presence and absence of VAMA indicates a significant ameliosative effect of VAMA at the higher levels of exchange sodium caused presumably by improvement in the physical condition of these soils. At the lowest level of exchange sodium, a slight inhibitory effect of VAMA on yields was noted.

Bingham, F. T., and Martin, J. P. EFFECTS OF SOIL PHOSPHORUS ON GROWTH AND MINOR ELEMENT NUTRITION OF CITRUS. Soil Sci. Soc. Amer. Proc. 20: 382-385. 1956.

The effect of phosphorus fertilization of three different soils on the growth and minor element nutrition of citrus was evaluated in greenhouse studies. These soils were collected from uncultivated areas in San Diego County, Calif., where citrus had benefited from P fertilization. The soils were placed in 3-gallon crocks and treated with monocalcium phosphate in amounts equivalent to 0, 76, 360, and 900 lbs. P per acre. Budded lemons and/or sour orange seedlings were subsequently planted in these soils. After 6 months of growth the plant tops were harvested, weighed, and analyzed. In later experiments the soils were pretreated with Cu at the rate of 20 ppm. Cu, and tested for P interrelations using only sour orange seedlings as indicator plants.

Severe Cu deficiencies were induced in the citrus plants by as little as 360 lbs. P per acre. Plant growth in the soils treated with high concentrations of P was greatly reduced when compared to that of the controls. Typical symptoms of Cu deficiency as well as markedly reduced leaf Cu values were associated with the heavy P treatments. Pretreating the soil with Cu at the rate of 20 ppm. Cu only partially modified the P-Cu effect. Zinc absorption also was reduced by excessive P fertilization. Iron and Mn appeared to be unaffected.

Boawn, L. C., and Viets, F. G., Jr. ZINC FERTILIZER TESTS ON SUGAR BEETS IN WASHINGTON. Jour. Amer. Soc. Sugar Beet Technologists, Vol. IX, No. 3, pp. 212-216. 1956.

The experimental evidence obtained to date would seem to justify several fairly definite conclusions with respect to the use of zinc fertilizers on sugar beets in the state of Washington. First, it has been shown that, for the most part, soils of the Yakima Valley and Columbia Basin can be expected to supply sufficient zinc for high yields of beets.

The second conclusion which these data support is that the zinc concentration of young, fully-developed leaf blades taken in mid-August must be below approximately 10 p.p.m. before the beet plant will show zinc deficiency symptoms or respond to zinc fertilization. Most of the leaf samples analyzed show a zinc content well above this figure.

Brazeale, E. L., and McGeorge, W. T. RELATION BETWEEN ELECTRICAL CONDUCTANCE AND CATION UPTAKE BY TOMATO PLANTS. Soil Sci. 80(5): 375-380. Nov. 1955.

When a growing plant is connected to the negative pole of an electropode, the positive pole attached to the medium in which the plant is growing, and the plant subjected to specific cation voltage, there is a diurnal fluctuation in conductance with the tissue. The fluctuation in conductance parallels a fluctuation in uptake of cations. The fluctuation in conductance and cation uptake are properties of living tissue.

Brown, J. C. IRON CHLOROSIS. Plant Physiology 7: 171-190. 1956.

A continuous source of available iron appears necessary for the growth of all plants. The fact that iron chlorosis can be corrected in plants growing in the presence of the bicarbonate ion, excess heavy metals, or excess phosphate, or in calcareous soils by applying an available source of iron to the soil, provides strong evidence that iron deficiency is caused by a lack of available iron in the rooting medium.

Caro, J. H., and Hill, W. L. CHARACTERISTICS AND FERTILIZER VALUE OF PHOSPHATE ROCK FROM DIFFERENT FIELDS. Agr. and Food Chemistry, Vol. 4, No. 8, p. 684, Aug. 1956.

As part of a systematic investigation of fertilizer value, solubility in fertilizer solvents, surface properties, physical properties of particles, and chemical composition of several types of phosphate rock were measured. Foreign rocks from Tunis and Curacao gave the highest solubilities, followed in order by domestic varieties from South Carolina, Florida, Idaho, Tennessee, and Virginia. The Tunis rock ranked highest and the Virginia apatite lowest in gas adsorption surface area and readily exchangeable phosphorus. Measurement of weight and density of closely sized particles indicated that the Tunis, Morocco, Florida, and South Carolina rocks were relatively light and of low density. Particle compactness lowers the reactivity of a rock. The chemical composition of the apatite component has appreciable influence on nutrient value. Statistical comparison of all laboratory measurements with crop yields in greenhouse culture showed that phosphate-bound carbonate content and citric acid solubility were the criteria giving best agreement.

Caro, J. H. and Hill, W. L. DETERMINATION OF SURFACE AREA OF DICALCIUM PHOSPHATE BY ISOTOPE EXCHANGE. Agr. and Food Chem., Vol. 4, No. 5, p. 436, May 1956.

The fineness of radioactive and nonradioactive dicalcium phosphate must be evaluated as one phase of a program for the characterization of the water-insoluble phosphate components of mixed fertilizers. The fineness of the phosphate grains generally lies below the practical sieve range. A technique for the rapid and fairly accurate estimation of surface area uses isotope exchange, whereby isotope ratios in biphase systems containing two elemental isotopes attain constancy in each phase at equilibrium. Determination of solution activity and concentration as the test sample reacts with a reagent solution containing the isotopes provides a measure of exchangeable phosphorus, which is compared with the phosphorus surface density, found by calibration of standard samples by gas adsorption measurements, to yield a measure of total surface area.

Cooke, G. W. FIELD EXPERIMENTS ON PHOSPHATE FERTILIZERS. Jour. Agr. Sci. 48: 74-103. 1956.

The results of over 400 field experiments testing different kinds of phosphate fertilizers are summarized and are discussed with special reference to the reactions of the soils used. The classifications were: (1) very acid soils--pH below 5:5, (2) acid soils--pH 5.6 to 6.5, (3) neutral soils--pH over 6.5. All comparisons are made in terms of fertilizers supplying the same amounts of total phosphorus.

Silicophosphate was practically as effective as superphosphate for rutabagas grown on very acid and acid soils; it was less efficient on neutral soils. For potatoes silicophosphate was nearly as effective as superphosphate on very acid soils; it was much less efficient on acid and neutral soils. Silicophosphate was roughly equivalent to high-soluble basic slag for grassland.

Cooper, H. P., and Hall, E. E. SIGNIFICANCE OF THE COEQUAL EFFECT OR BALANCED-BAULIC-POUNDAGE RATIO OF MAJOR FERTILIZER NUTRIENTS TO RELATIVE PERCENTAGE GROWTH RESPONSE IN CROP PLANTS. Soil Sci. 82: 201-216. Sept. 1956.

The Mitscherlich-Baule-Willcox system of determining calculated yields from fertilizer experiments were used in interpreting certain yield data. The relative percentage plant growth response from the addition of successive baule unit increments of major fertilizer nutrients followed the halved diminishing increment exponential growth curve. The ratio of N to P_2O_5 in leguminous crop plants was found to be in close agreement with the coequal effect ratio. The ratio of P_2O_5 to K_2O at lower levels of soil fertility was in close agreement with the balanced coequal effect nutrient ratio. The ratio of nutrients in crop plants offered a relatively quick method of estimating the relative sufficiency of fertilizer nutrients for the conditions under consideration.

Crooke, W. M. EFFECT OF SOIL REACTION ON UPTAKE OF NICKEL FROM A SERPENTINE SOIL. Soil Sci. 81(4): 269-276. 1956.

In pot experiments with a serpentine soil, increase in soil pH, whether produced by $CaCO_3$ or Na_2CO_3, was found to reduce Ni extractable by ammonium acetate and also that absorbed by oat plants.

Laboratory studies were made of the recovery of Ni added to a granitic soil limed by either $CaCO_3$ or Na_2CO_3. Increase in soil pH was found to reduce recovery.

The results of the experiments suggest that the reduction in toxicity symptoms and Ni absorption produced by liming of these serpentine soils in the field depends on a reduction in available Ni due to change in soil pH, rather than of the improved Ca status of the soil.

In a peaty serpentine soil, there are indications that part of the Ni exists as a complex with the soil organic matter.

Davies, E. B. FACTORS AFFECTING MOLYBDENUM AVAILABILITY IN SOILS. Soil Sci. 81: 209-221. 1956.

Alkaline and organic soils are prone to produce herbage of high molybdenum content and highly podzolized soils, soils with little capacity for retaining molybdenum, soils of high anion-exchange capacity and low pH, ironstone soils, and soils depleted by exhaustive cropping are prone to be deficient in molybdenum.

Davis, J. F., Hulburt, W. C., Hansen, C. M., and Shepherd, L. N. THE EFFECT OF FERTILIZER PLACEMENT ON THE YIELD OF ONIONS AND SPINACH GROWN ON ORGANIC SOIL. Quar. Bull., Mich. Agr. Expt. Sta., Vol. 39, No. 1, pp. 25-35. Aug. 1956.

Method of fertilizer application caused yields of onions and spinach to vary as much as 103 and 50 percent, respectively.

The results indicate that fertilizers for these two crops should be placed in a band 2 inches below the seed level or in a band 1 inch to the side and 2 inches below the seed level.

Quantities in excess of 800 pounds of 5-10-20 per acre should be applied ahead of planting with a fertilizer grain drill, be broadcast on the surface, or be plowed under.

The amount of fertilizer that can be safely applied in a band 2 inches below the seed depends on the amount of moisture in the seedbed at planting time, the row spacing, and the performance of the fertilizer applicator in maintaining the desired depth of 2 inches below the seed throughout all of the planting area.

Eck, H. V., and Stewart, B. A. NITROGEN FERTILIZATION OF WINTER OATS. Okla. A&M College, Okla. Expt. Sta. Bull. No. B-491. May 1957.

This publication reports the results of an experiment designed to determine the effect of nitrogen fertilization on the yield of winter oats and to determine the effect of previous cropping systems on the response of winter oats to nitrogen fertilization. It was conducted during the four-year period, 1952-56, on the college agronomy farm in Stillwater.

Eck, H. V., and Stewart, B. A. PROGRESS REPORT, WHEAT FERTILIZATION STUDIES IN WESTERN OKLAHOMA, 1954-55. Okla. A. & M. College Prog. Rpt. Oct. 1956.

The 1954-55 results of wheat fertility experiments at 11 locations in western Oklahoma furnished information for the following conclusions:

Nitrogen fertilization brought about a significant increase in yields at only one location. Applications of nitrogen as high as 160 pounds per acre did not decrease yields under very severe drouth conditions. Protein content of the grain increased with increasing rates of nitrogen application. Time of nitrogen application had no effect on yield at four of eleven locations. Phosphorus fertilization brought about significant increases in yield at four locations. Where phosphorus gave yield increases, 20 pounds of P_2O_5 per acre was sufficient to give maximum increases. Results from current and previous work and observations point to the conclusion that the first limiting nutrient element in wheat production in western Oklahoma is phosphorus. When the required phosphorus is supplied and suitable climatic conditions prevail, nitrogen fertilization is profitable.

Ensminger, L. E., and Pearson, R. W. RESIDUAL EFFECTS OF VARIOUS PHOSPHATES AS MEASURED BY YIELDS, P^{32} UPTAKE, AND EXTRACTABLE PHOSPHORUS. Soil Sci. Soc. Amer. Proc. 21: 80-84. 1957.

In 1930 an experiment was started on a Decatur silt loam and on a Greenville fine sandy loam to compare the effectiveness of different sources of phosphorus for crops grown in a rotation of corn and cotton with vetch. At the end of 16 years, phosphate applications were discontinued in order to study residual effects on yields. In 1950 and 1951, tagged superphosphate was applied to all treatments and available phosphorus, based on P^{32} uptake, was calculated and expressed as $\underline{A}$ values.

Yield data from both locations show that all sources had considerable residual effects. For any particular source, the residual effect was in proportion to the amounts that had been added. Basic slag gave the greatest residual effect on the Decatur soil as measured by vetch and cotton yields. It also gave the greatest residual effects on the Greenville soil as measured by cotton yields. Tricalcium phosphate and raw phosphate showed a much greater residual effect, as indicated by vetch yields, in the Greenville soil than in the Decatur soil.

$\underline{A}$ values show that all sources had considerable residual effects as measured by radiophosphorus uptake. The $\underline{A}$ values for basic slag at both locations were larger than for an equivalent amount of any other source. For the Greenville soil, $\underline{A}$ values show that superphosphate had a greater residual availability than rock phosphate applied at twice the rate of P_2O_5. However, $\underline{A}$ values on the Decatur soil indicate that rock phosphate had about the same residual availability as superphosphate applied at an equivalent rate of P_2O_5. For any particular source, $\underline{A}$ values were in proportion to the amounts which had been added.

Yield data for the first 4 years of the residual period show only a very general relationship with $\underline{A}$ values when all sources are considered together. However, correlation coefficients show a fairly close relationship between yields and $\underline{A}$ values in most cases when the analysis is limited to rates of one source.

Extractable phosphorus data show that phosphate applications resulted in phosphorus accumulation and that the amount accumulated was proportional to the rate of application.

Evans, Harold J. ROLE OF MOLYBDENUM IN PLANT NUTRITION. Soil Sci. 81: 199-208. 1956.

Molybdenum is an essential element in the process of nitrogen fixation, and in nitrate reduction in plants when this source of nitrogen is utilized. It is, however, not a role which is limited to these two physiological processes, for plants grown upon combined nitrogen sources other than nitrate still require molybdenum for nominal growth. The magnitude of the molybdenum requirements for nitrogen fixation and nitrate reduction is greater than that for the utilization of the reduced combined nitrogen sources. It is concluded that there is convincing evidence that molybdenum functions as an electron carrier in the flavoprotein-nitrate reduct uses recently isolated from soybean leaves, Neurospora and Escherichiacoli. This adequately accounts for the accumulation of nitrate in tissues of plants that are deficient in molybdenum. There is strong evidence that molybdenum may play a role in the inhibition of plant phosphates. But the relation of this element to ascorbic acid accumulation and diminished capacity for dye reduction; and to orion metabolism, all of which have been associated with deficiency of the element, remains obscure.

Ferguson, W. S., and Terry, R. A. THE EFFECT OF NITROGENOUS FERTILIZERS ON THE NON-PROTEIN NITROGENOUS FRACTION OF GRASSLAND HERBAGE. Jour. Agr. Sci. 48(2): 149-152. 1956.

The non-protein nitrogenous fraction of grassland herbage given a range of repeated nitrogenous fertilizer treatments was examined. The herbage was intended for conservation and the treatments were 0, 200, 400, and 600 pounds calcium nitrate per acre cut, applied early, after cutting, and late, 10-14 days before cutting. The nitrogen treatment produced sods of low clover content.

Frederick, L. R., Starkey, R. L., and Segal, W. DECOMPOSABILITY OF SOME ORGANIC SULFUR COMPOUNDS IN SOIL. Soil Sci. Soc. Amer. Proc. 21: 287-292. 1957.

Various organic sulfur compounds decomposed at different rates in soil under aerobic conditions. The sulfur was released rapidly from some compounds (mostly of natural origin) but only in negligible amounts from others. As estimated by formation of sulfate, the following compounds decomposed rapidly: cystine, taurine, sodium taurocholate, sulfosalicyclic acid, and formaldehyde-sodium-sulfoxylate. Decomposition of the last compound may have been non-biological, at least in part. Thiamine decomposed slowly and there was slight decomposition of thiourea. There was no evidence of decomposition of the following: sulfanilic acid, sulfanilamide, sulfathiazole, sulfapyridine, mercaptoethanol, sodium diethyl-dithiocarbamate, an alkyl-arylsulfonate, p-thiocresol, 2-mercapto-benzothiazole, sulfonmethane, phenyl thiourea, potassium ethyl xanthate, and ammonium sulfamate. Decomposition of the organic sulfur compounds as determined by sulfate production was not related to any type of sulfur linkage.

Decomposition of methionine was markedly different from that of the other sulfur compounds in that sulfate was not an end product. The sulfur was recovered as the volatile sulfur product methylthiol and dimethyl disulfide. The results indicate that the methylthiol was produced and that the dimethyl disulfide arose from oxidation of methylthiol.

The abundance of soil microorganisms increased in the soils to which those organic compounds were added from which sulfate was formed. Thiourea, phenyl thiourea, and mercaptoethanol were toxic to the soil population at the concentrations of 1% or more that were used.

Fine, L. O. NITROGEN REQUIREMENTS IN THE JAMES RIVER BASIN. So. Dak. Farm and Home Res., Vol. VII, No. 4, pp. 94-97, 1956.

The place of nitrogen fertilizer use in the James River Basin at this time appears to be primarily on small grains; secondly, on tame grass hay or pasture when adequate moisture is present or irrigation will be used; and thirdly, on corn and other row crops when a legume has not been on the land in the 2 or 3 years immediately preceding. The amount to be applied in any case, of course, must be determined from soil test information, cropping history, knowledge of the soil type, and moisture conditions.

Fine, L. O. THE INFLUENCE OF NITROGEN AND POTASSIUM ON THE AVAILABILITY OF FERTILIZER PHOSPHORUS. Bull. 453, So. Dak. Agr. Expt. Sta., Nov. 1955.

Increased available potassium in the soil attained by the use of potassium fertilizers had little effect on fertilizer phosphorus utilization by crops of the North Central Region. Initial exchangeable soil potassium appeared to have no effect on the recovery of fertilizer phosphorus as measured by oats, corn, and alfalfa. Application of potassium with phosphorus in the fertilizer band likewise had no significant effect on the phosphorus content of oats and corn. However, potassium applied with phosphate in a broadcast application for alfalfa significantly lowered the phosphorus content of alfalfa in a Minnesota trial.

Flocker, W. J., and Fuller, W. H. AVAILABILITY OF CALCIUM IN CALCAREOUS SOILS. Soil Sci. Soc. Amer. Proc. 20: 387-391. 1956.

Ten Arizona soils ranging in calcium carbonate content from 0 to 13% were collected and tested under greenhouse conditions for available calcium using soluble radiocalcium and radiostrontium salts for A value measurements. Neither the total amount of radio-element absorbed nor the percentage of radio-element in the plant derived from the added source was found to be related to the soil calcium soluble in water or 1:1 HCl, the calcium carbonate content or "active" calcium as measured by the Drouineau method. Further study showed that plants took up more soil calcium from acid soils of the humid Midwest than from some calcareous soils of Arizona. The amount of exchangeable calcium in soils was significantly correlated with the amount of available calcium in soils. Calcium carbonate was found to be very poorly available to plants regardless of its source.

Freeman, B. N., and Humphrey, R. R. THE EFFECT OF NITRATES AND PHOSPHATES UPON FORAGE PRODUCTION OF A SOUTHERN ARIZONA DESERT GRASSLAND RANGE. Jour. Range Mgt. 9: 176-180. 1956.

The effects of applications of superphosphate, ammonium phosphate, and ammonium nitrate fertilizers on forage quantity and quality were studied on a typical desert grassland in southern Arizona. Fertilizer applications were made at rates of 100, 200, and 400 pounds per acre.

Superphosphate fertilization, except at the 400-pound-per-acre rate, resulted in only slight increases in forage production and green-feed period. Available soil phosphate increased markedly in the surface foot of soil. Curly mesquite and sprucetop grouse showed a corresponding increase in phosphorus content after phosphate fertilization.

Fertilization with ammonium phosphate and ammonium nitrate gave significant increases in forage production and the green-feed period of grasses. They also increased the content of the respective elements in forage.

Fuller, W. H., and Nielsen, D. R. THE INFLUENCE OF STRAW AND STRAW-FERTILIZER COMPOSTS ON THE UPTAKE OF FERTILIZER PHOSPHORUS BY PLANTS. Soil Sci. Soc. Amer. Proc. 21: 278-282. 1957.

The application of solutions of inorganic phosphorus fertilizers to crop residues before the residues are tilled into the soil is now a widespread practice in the Southwest. This practice is centered around the hope that the fertilizer phosphorus will remain at a higher level of availability as a result of this procedure than if it were added directly to the soil. The hypothesis is that phosphorus fixed by microorganisms during the decomposition of the crop residue is only temporarily unavailable to plants. Phosphorus fixed by this method presumably would be made readily available to plants during the latter stages of decomposition of the residues in contrast to the irreversible fixation by the inorganic constituents of the soil.

Results with wheat straw and wheat straw composts containing tagged phosphorus indicate that a relatively greater amount of phosphorus is utilized by plants from compost than from noncompost material. The compost had lost 40 to 50% of its original weight as a result of decomposition before being added to the soil. On the other hand, results with phosphorus-free extracted oat straw showed that the less decomposed material (oat straw plus KH_2PO_4) supplied more P to ryegrass growing on Mohave clay loam than the compost (oat straw composted with KH_2PO_4). However, the extracted oat straw composts did not decompose to an extent to exceed 20% before being added to the soil.

According to the data obtained, it must be concluded that there is no particular advantage of adding liquid phosphoric acid fertilizers directly to straw before incorporating them into calcareous soils over the practice of applying the fertilizer and straw residues independently.

Godfrey, C. L., and Riecken, F. F. SOLUBILITY OF PHOSPHORUS IN SOME GENETICALLY RELATED LOESS-DERIVED SOILS. Soil Sci. Soc. Amer. Proc. 21: 232-235. 1957.

Phosphorus solubility studies were made on five loess-derived soils showing increased profile development in relation to their location along a traverse from southwestern Iowa to northern Missouri. The pH of the extractant varied from about 2.0 to 11.0. This technique was used to determine the general chemical nature of the inorganic phosphorus compounds in each profile.

The results showed the acid, near neutral, and alkaline soluble phosphorus to be a function of the position of the sample in the profile and to be further related to the degree of profile development--the A, B, and C horizons showing definite solubility patterns. The A horizons yielded about equal yet small amounts of phosphorus both in the acid and alkaline media. In the B horizons the alkaline extractions removed much more phosphorus, while in the C horizons the acid media not only solubilized more phosphorus but very much more than at any other position in the profiles. All horizons of all profiles showed low soluble phosphorus in the neutral media. The more strongly developed profiles tended to be lowest in soluble phosphorus showing the tendency of the soil development processes to fix the phosphorus compounds into less soluble forms. The study indicates that soil weathering tends to change the inorganic phosphorus from calcium forms to iron, aluminum, and adsorbed forms, but that organic matter retards this action and forms other complexes both alkaline and acid soluble.

Guttay, J. R., Stritzel, J. A., Englehorn, A. J., and Black, C. A. TREATMENT OF CORN SEED WITH PHOSPHATE. Agronomy Jour. 49: 98-101. 1957.

The weight of young corn plants in soil cultures in the greenhouse was found to increase with the content of phosphorus present naturally in the seed independently of seed weight. In field experiments, supplementation of the natural phosphorus content of each seed with 6 mg. of P as $NaH_2PO_4 \cdot H_2O$ applied in a glue coating resulted in an average corn yield 4.5 bushels per acre above that produced from seed treated with glue alone.

Haddock, J. L., and Linton, D. C. YIELD AND PHOSPHORUS CONTENT OF CANNING PEAS AS AFFECTED BY FERTILIZATION, IRRIGATION REGIME, AND SODIUM BICARBONATE-SOLUBLE SOIL PHOSPHORUS. Soil Sci. Soc. Amer. Proc. 21: 167-171. 1957.

Yield of both pea vines and canning peas were increased significantly by phosphorus fertilizers. Yield response was in the order: current season applied phosphorus >1 year residual >2 year residual. Yield of pea vines and canning peas were increased significantly for increases in water application in the order: 5 inches < 8 inches < 10 inches >12 inches.

Time of sampling pea vines for chemical analysis was shown to be an important factor if it is desired to relate yields to the soluble phosphorus content of plant tissue, or soluble phosphorus content of plant tissue with irrigation regime.

Relationships between sodium bicarbonate-soluble phosphorus and phosphorus in the plant and between yield of peas and phosphorus content of plant tissue are shown.

Haley, L. E., and Melsted, S. W. PRELIMINARY STUDIES OF MOLYBDENUM IN ILLINOIS SOILS. Soil Sci. Soc. Amer. Proc. 21: 316-319. 1957.

Various methods of extracting molybdenum from soils have been examined and results compared with the total soil molybdenum and plant composition. The reagents employed for extracting molybdenum were 0.1 N NaOH, 0.275 M oxalate, 0.1 N NCl + 0.03 N NH_4F, and 0.03 N NH_4F. Total molybdenum was determined by a modification of the method of Grigg and Perrin. Plant analyses were made by the method of Johnson and Arkley.

Total molybdenum in the soils studied ranged from 1.90 ppm. to 3.20 ppm. whereas the plant samples ranged from 0.27 ppm. to 10.65 ppm. molybdenum. The following sequence of extraction of molybdenum was observed: 0.1 N NaOH > Tamm's acid ammonium oxalate > 0.03 N NH_4F > 0.1 N NCl + 0.03 N NH_4F. The only forms of soil molybdenum that gave statistically significant correlations with plant composition were the forms extracted by sodium hydroxide and acid ammonium oxalate.

Halstead, R. L., MacLean, A. J., and Lutwick, L. E. AVAILABILITY OF PHOSPHORUS IN SOILS PRE-TREATED WITH SUPERPHOSPHATE. Canadian Jour. Agr. Sci. 36: 471-482. 1956.

In a greenhouse experiment different rates of superphosphate were incorporated in nearly neutral surface soil samples from three farms on each of three soil types, and after the treated soil was kept moist for a 6-week period, alfalfa was grown during a 2-year period. The uptake of phosphorus by the crop increased with increasing rates to 2000 lb. (P_2O_5) per acre, the highest rate employed. The average phosphorus content of the plants grown in the first year increased from 0.18 percent without superphosphate to 0.54 percent with the heaviest application, a pre-treatment of 2000 lb. (P_2O_5) per acre.

The amounts of Truog acid-soluble, Bray adsorbed, and $NaHCO_3$-soluble phosphorus in the untreated samples were correlated with "a" values calculated from regression equations relating the uptake of phosphorus by the crop in the first year to the phosphate pre-treatments.

In terms of acid-soluble, adsorbed, $NaHCO_3$-soluble, and water-soluble phosphorus, the recovery per unit of added phosphate increased in most instances with increasing rates. The amounts of Bray adsorbed and of $NaHCO_3$-soluble phosphorus in the same samples were similar. The average recovery of phosphate added to the soils at the rate of 200 lb. (P_2O_5) per acre was 42 percent for acid-soluble phosphorus and 35 percent for $NaHCO_3$-soluble phosphorus. The amounts of water-soluble phosphorus were higher than those obtained by extraction with a 0.01 M $CaCl_2$ solution. The variations in soluble phosphorus occurring between the different soil samples were similar for the water and salt solution.

Halstead, R. L., Nielsen, K. F., and MacLean, A. J. PHOSPHORUS AND POTASSIUM SUPPLY FOR ALFALFA IN SOILS SAMPLED AT DIFFERENT DEPTHS. Canad. Jour. Agr. Sci. 37: 61-70. 1957.

Results of a greenhouse experiment, comprising soil samples taken at three depths from each of six locations in eastern Ontario, indicated that the phosphorus-supplying power of the surface was considerably greater than that of the corresponding subsurface samples of four of the soils. The relative amounts of total phosphorus in surface and subsurface samples varied with the soils, the most pronounced variation being an increase in a sandy soil with depth. The proportion of the total phosphorus found in organic form varied from 18 to 56 percent in the surface and from 5 to 33 percent in the subsurface samples. The amounts of acid-soluble phosphorus extracted from five of the soils increased with depth. The amounts of $NaHCO_3$-soluble phosphorus were higher in the surface than in the subsurface samples of five of the soils. The values for acid-soluble phosphorus in five of the soils and for $NaHCO_3$-soluble phosphorus in three of the soils were not in agreement with greenhouse results.

The data from the greenhouse experiment did not indicate a pronounced difference between the potassium-supplying powers of corresponding surface and subsurface samples. Exchangeable potassium did not vary appreciably between surface and subsurface samples of four of the soils but decreased in two of the soils with depth. Water-soluble potassium decreased with depth in most instances.

Hanway, J. J., Scott, A. D., and Stanford, G. REPLACEABILITY OF AMMONIUM FIXED IN CLAY MINERALS AS INFLUENCED BY AMMONIUM OR POTASSIUM IN THE EXTRACTING SOLUTION. Soil Sci. Soc. Amer. Proc. 21: 29-34. 1957.

Fixed NH_4 in vermiculite and bentonite was completely released by distillation in NaOH solutions. Small amounts of K in the solutions, however, blocked this release of NH_4. If the amount of K was in excess of 2 K ions per 100 Na ions, no fixed NH_4 was released from vermiculite. With smaller amounts of K present, the amount of fixed NH_4 released decreased as the K/Na ratio in solution was increased. In an equilibrium NaCl extraction, small amounts of either fixed ion, NH_4 or K, in the solution prevented the release of fixed NH_4. There was no blocking from the NH_4 in the NaOH distillations since it was lost from the alkaline systems. In the salt solutions, NH_4 was more effective than K in blocking the release of fixed NH_4. The blocking effect of a given fixable/nonfixable ion ratio in the neutral salt solutions increased as the amount of salt extractant per gram of mineral was increased. This is due to the preferential adsorption of the fixable cations. Higher K/Na ratios were required to block the release of fixed NH_4 in neutral salt solutions than in alkaline solutions. Ten K ions per 100 Na ions in NaCl were not as effective as 2 K ions per 100 Na ions in NaOH. Higher K/Na or NH_4/Na ratios were required to block the release of fixed NH_4 from bentonite than from vermiculite. The NH_4/Na ratio required to completely prevent the release of fixed NH_4 from bentonite by NaCl was 0.04 as compared to 0.02 for vermiculite.

Harper, H. J. EFFECT OF RAINFALL AND FERTILIZATION ON THE YIELD AND CHEMICAL COMPOSITION OF ALFALFA OVER A 10-YEAR PERIOD IN NORTH CENTRAL OKLAHOMA. Soil Sci. Soc. Amer. Proc. 21: 47-51. 1957.

Climatic environment had a greater influence than soil treatment on the quantity of nitrogen, calcium, potassium, magnesium, and phosphorus in 26 cuttings of alfalfa hay grown on the Oklahoma Agricultural Experiment Station, Perkins Farm, from 1937 to 1946. The protein content of the first cutting of alfalfa was equal to, or higher than, the protein content of the second or third cuttings of hay in 8 out of 9 years. The calcium content of the hay was usually high when soil moisture was low, and low when soil moisture was high during the growing period. The minimum and maximum percent of calcium in different cuttings varied nearly 100%. The potassium and phosphorus content of different alfalfa cuttings varied more than 100%. A luxury potassium consumption by alfalfa occurred on this soil. Lower phosphorus percentages usually were observed in the alfalfa hay when rainfall was low for several weeks before the crop was cut. Factors which increased or decreased the quantity of phosphorus obtained by the alfalfa plants from the natural phosphates in the soil had a similar influence on the uptake of applied phosphates. The average absorption of phosphorus from rock phosphate by alfalfa was similar to the quantity of phosphorus obtained from superphosphate on unlimed soil, but was slightly lower on the limed plots. A greater variation occurred in the nitrogen and phosphorus content of the stems than in the leaves of mature alfalfa plants grown on variously treated plots.

Harris, D. G., and van Bavel, C. H. M. NUTRIENT UPTAKE AND CHEMICAL COMPOSITION OF TOBACCO PLANTS AS AFFECTED BY THE COMPOSITION OF THE ROOT ATMOSPHERE. Agron. Jour. 49: 176-181. 1957.

The roots of tobacco plants were subjected to a wide range of simulated aeration conditions. In general nutrient uptake remained relatively constant until oxygen concentrations dropped below 10%. However, a concentration of 5% carbon dioxide apparently stimulated phosphorus uptake.

Harward, M. E., Jackson, W. A., Piland, J. R., and Mason, D. D. THE RELATIONSHIP OF CHLORIDE AND SULFATE IONS TO FORM OF NITROGEN IN THE NUTRITION OF IRISH POTATOES. Soil Sci. Soc. Amer. Proc. 20: 231-236. 1956.

A greenhouse experiment using sand cultures was conducted to study the role of chloride and sulfate anions in the nutrition of Irish potatoes when different forms of nitrogen were used. The experiment consisted of two series, the first in which all N was supplied as NO_3- and the second in which both NH_4+ and NO_3- were present. Treatments within each series consisted of plants receiving different amounts of sulfate and chloride. The initial solution concentrations of all ionic species except NH_4+, NO_3-, Cl-, and SO_4= were the same for each treatment.

Two distinct foliar symptoms associated with treatments were observed. The first, a tip burn associated with high SO_4= treatments, was more severe when NH_4+ was present than when NO_3 - was the only source of N. The second, characterized by rolling of the leaves, was obtained only with Cl- treatments in the presence of NH_4+. This was not observed when NH_4+ was used in the absence of Cl- or when NO_3 - was added in the presence of either Cl- or SO_4=.

Increasing Cl- and decreasing SO_4= concentrations in the presence of NH_4+ resulted in marked reduction in the yield of fibrous roots. Additions of Cl- generally resulted in decreases in the percentage of dry matter in the tops and this effect was more pronounced in the presence of NH_4+. In the NH_4NO_3 series, reductions in chlorophyll content resulted from increased supply of Cl- and simultaneous decrease of equivalent amounts of SO_4=. No change in these pigments was obtained in the NO_3- series. The mineral content of the potato leaves was affected both by form of N and by Cl- and SO_4= concentrations. The Cl- content of the leaves was markedly increased in the presence of NH_4+.

Hauck, R. D., and Melsted, S. W. SOME ASPECTS OF THE PROBLEM OF EVALUATING DENITRIFICATION IN SOILS. Soil Sci. Soc. Amer. Proc. 20: 361-364. 1956.

There is need for methods which will enable one to study directly the gaseous products of nitrate reduction in the field. Accurate determinations of complete nitrogen balances for laboratory soil systems are necessary to evaluate the extent of denitrification in the field. The mass spectrometer and the infra-red spectrophotometer were used to determine quantitatively the production of nitrogen (N_2) gas and nitrogen oxides, respectively, from laboratory soil containing nitrate nitrogen enriched with N^{15}. Chemical analyses of total organic and inorganic nitrogen were made to complete the nitrogen balance sheets. From 89 to 100% of the total nitrogen contained in a closed system was accounted for by direct analyses in this manner.

Hewitt, E. J. SYMPTOMS OF MOLYBDENUM DEFICIENCY IN PLANTS. Soil Sci. 81(3): 159-171. Mar. 1956.

Loss of chlorophyll, mottling, wilting, microsis, and scorching symptoms are invariably associated with use of nitrate in culture experiments and are independent of presence of additional ammonia. The mottling is associated with an accumulation of nitrate or oxidizing compounds and localized distribution of molybdenum in the leaves. Crop sensitivity differs. The characteristic appearance and high sensitivity of certain plants permits their use as indicator crops for diagnostic purposes.

Holden, E. R., and Engel, A. J. RESPONSE OF ALFALFA TO APPLICATIONS OF A SOLUBLE BORATE AND A SLIGHTLY SOLUBLE BOROSILICATE GLASS. Agr. and Food Chem. 5: p. 275. 1957.

Boron response of Ranger alfalfa grown from Evesboro sandy loam to additions of a coarsely ground experimental borosilicate glass has been compared to that of borax under greenhouse conditions. The concentration of boron in the plant tended to become approximately proportional to application and to reach a minimum value, in each treatment, during late summer growth. Significant increases in yield were produced by borax from 5 to 80 pounds and by glass from 12 to 360 pounds per acre, indicating that a material of intermediate solubility could be used to better advantage.

Humbert, R. P., and Ayres, A. S. THE USE OF AQUA AMMONIA IN THE HAWAIIAN SUGAR INDUSTRY: II. INJECTION STUDIES. Soil Sci. Soc. Amer. Proc. 21: 312-316. 1957.

The shift from solid forms of nitrogen fertilizer to aqua ammonia has resulted in an annual saving to the Hawaiian sugar industry in excess of $1,000,000. Where reasonably good water distribution is obtained, aqua is successfully applied in the irrigation stream. Results of 35 tests show an average decrease in nitrogen content of 21% as ammoniated irrigation water flows from the head to the tail of 200-foot furrows. About 20% of the decrease was found by tests in plastic lined furrows to be due to volatilization. Ammonia applied in the irrigation water is retained in the top few inches of soil. It is rapidly nitrified, and is then carried downward by subsequent irrigation.

Laboratory studies of aqua ammonia applied directly to the surface of acid soils showed losses up to 15%. In alkaline soils where application rates exceed the ammonia saturation capacity of the soil, volatilization losses can exceed 50% even when placed at depths of 4 inches.

On the unirrigated plantations, aqua is applied by injection at rates of 60 to 200 pounds of N per acre either with the seed at planting, or near the stools at ratooning. Laboratory and field studies show, that at the high concentrations of ammonia obtained by injection, nitrification is retarded. This minimizes loss by leaching and results in effective utilization of the applied nitrogen.

Hunter, A. S., Yungen, J. A., and Alban, L. A. TWO APPROACHES TO DETERMINATION OF THE FERTILITY STATUS OF MALHEUR COUNTY, OREGON, SOILS. Soil Sci. Soc. Amer. Proc. 21: 210-215. 1957.

The fertility status of the irrigated soils of Malheur County was investigated through field experiments on sites selected on a non-random basis and by a survey of the nutrient status of the soil, using alfalfa as an indicator crop, on sites chosen at random.

The data from 66 field experiments, on 6 major crops on 40 farms, over a 4-year period led to the conclusions that although the level of soluble P was fairly low in several soils, under the prevailing conditions of farming only a few soils were deficient in P for the needs of the current crop, and that all soils are adequately supplied with K. Selection of sites for these field experiments was made on the basis of probable good cooperation of individual farmers. This method of selection could be biased towards the lands of the more progressive farmers, who may maintain higher than average fertility levels in their soils, in which case erroneous conclusions regarding the nutrient status of the soils of the area might be drawn. The conclusions from the field experiments were tested by making a survey of alfalfa yield and the P and K status of alfalfa and soil on approximately 150 sites chosen strictly at random.

Comparison of data from field experiments and survey reveal some bias in conclusions from field experiments as regards soil levels of P, which element has been in use in the area as a fertilizer for several years. Soils from field experiments were in general considerably higher in sodium bicarbonate-soluble P than soils from random sites. In the case of K, which has been used very little as a fertilizer in the area, experiments and survey led to similar conclusions.

Regression equations, calculated from the survey data, indicate that, in general, alfalfa yields in the area may be increased by increasing P and K in the soil. The equations indicate further that relatively large amounts of P and K are required to produce yield increases of the magnitude of the "least significant difference between treatment means" usually found in field experiments.

Islam, M. A. ROLE OF SOLID PHASE IN PHOSPHORUS NUTRITION OF PLANTS AS REVEALED BY RADIOACTIVE INDICATOR. Soil Sci. 81: 439-442. 1956.

Lettuce seedlings were grown in 0.4 percent suspension of electrodialyzed Aiker colloid less than 1 μ in diameter and treated with radioactive phosphorus P_{32}; others were grown in an artificial internuclear liquid of the same concentration of radioactive and ordinary phosphorus as a liquid phase of the suspension. The number of counts for the radioactive phosphorus was higher in plants in the suspension than in those in the artificial internuclear liquid. This indicates the possible plant utilization of phosphorus adsorbed on the soil colloids. Since the number of counts of radioactive phosphorus per milliter of suspension remains unaltered, it appears that the absorption of radioactive phosphorus by plants is increased by increasing the amounts of carrier phosphorus, and that thus the absorption of adsorbed phosphorus by plants is increased by increasing the degree of saturation of the colloid with respect to phosphorus.

Ivarson, K. C., and Pramer, D. THE PERSISTENCE AND BIOLOGICAL EFFECTS OF SURFACE ACTIVE AGENTS IN SOIL. Soil Sci. Soc. Amer. Proc. 20: 371-374. 1956.

Though surface active agents gain access to soil through agricultural sprays, little is known of their persistence and biological effects. Studies were made with the following surface active agents: (1) Tween 80 (non-ionic); (2) Ceepryn (cationic); (3) Nacconol NRSF (anionic).

Tween 80 decomposed rapidly in soil. Ceepryn was also decomposed following an initial lag period. Nacconol NRSF resisted decomposition.

Tween 80 had little or no undesirable biological effects in soil. At very high levels, Ceepryn reduced the total number of microorganisms in soil and inhibited nitrification. Nacconol NRSF was more detrimental than Ceepryn. It is suggested that the toxicity of ionic surface active agents is reduced as a result of adsorption by the colloidal fraction of soil. The cationic compound was adsorbed to a greater extent than the anionic compound.

Jordan, H. V., Crockett, S. P., and Bardsley, C. E., Jr. SOME EFFECTS OF KUDZU VERSUS CONTINUOUS CORN ON SOIL PROPERTIES AND CROP YIELDS. Soil Sci. Soc. Amer. Proc. 20: 225-227. 1956.

In a continuing study of means of improving a soil with genetic pan, kudzu, a deep-rooted perennial legume, was introduced in rotation with corn. Following 4 years of kudzu, the nitrogen, organic carbon, and exchangeable potassium in the 0 to 12-inch soil were higher than in continuous corn plots. The bulk density was lower, and the porosity, aggregation, and intrinsic permeability were higher on the kudzu plots. Evidence, both from soil moisture studies and from uptake of deeply-placed radioactive phosphorus, indicated deeper rooting of corn following the kudzu. Corn yields were increased as a result of growing the legume, and, particularly, in the absence of the legume, by supplemental nitrogen. Some data on the persistence of these effects are reported.

Kretschmer, Albert E., Jr., and Allen, R. J., Jr. MOLYBDENUM IN EVERGLADES SOILS AND PLANTS. Soil Sci. Soc. Amer. Proc. 20: 253-257. 1956.

Everglades organic soils are underlain with limestone rock, and with continued cropping subsistence occurs and pH values rise. A rather high total Mo content in these soils encouraged work to determine the Mo accumulation by plants as affected by soil factors. A survey of Mo and Cu contents of forages grown throughout the area also was made to determine the Mo status of forages being grazed. As an index of forage not harmful to grazing cows, a Cu content of 10 ppm., or greater and a Mo content of 3 ppm. or less in the forage was chosen from previous animal tests.

It was found that increasing the pH of the soil resulted in Mo accumulations of greater than 25 ppm. by clover plants. Not only is there a great difference between Mo contents of various winter forages grown under the same conditions, but contents seem to vary as a result of plant maturity and season. Roselawn St. Augustinegrass and Bermudagrass growing in commercial pastures were found to absorb less Mo than other grasses tested, while pangolagrass and white clover absorbed larger amounts. Furthermore, trends seem to indicate that plants grown on a given soil will accumulate more Mo as the period of cropping increases, even though the soil pH remains constant.

Although the Mo contents of permanent pastures are not as high as those reported in other troubled areas, the Mo-Cu status indicates the possibility of unfavorable forage quality during the fall. Average Mo and Cu contents of approximately 100 survey samples were found to be 5.5 and 7.4 ppm., respectively, in the fall, and 2.9 and 10.9 ppm. in the spring.

Leamer, R. W. FERTILIZER TRIALS ON ALFALFA, COTTON, AND SORGHUM IN NEW MEXICO. New Mexico Agr. Expt. Sta. Bull. 408, June, 1956.

The trials reported here have been conducted on farmers' fields in various parts of the state. Approved experimental procedures were used in all trials, and the results were evaluated by recognized statistical methods. The field sites represented an important type of soil in each area. The crops grown were those common to the area. Each experimental site was an integral part of a larger field and received the same irrigation, cultivation, and insect and/or disease control as the rest of the field.

Longenecker, D. E., and Lyerly, P. J. INFLUENCE OF SOURCE OF NITROGEN FERTILIZER ON YIELDS OF ACALA COTTON IN THE EL PASO VALLEY, 1955. Prog. Rpt. 1851. Tex. Agr. Expt. Sta., Feb. 24, 1956.

In two tests conducted on alluvial clay loam soils in the El Paso Valley in 1954, anhydrous ammonia gave slightly smaller yield increases than ammonium nitrate, ammonium sulfate and urea, but all nitrogen sources gave significant increases over plots receiving no nitrogen. Applications of superphosphate had little effect on yields.

Two tests in 1955 on lighter valley soils again showed significant yield increases for all sources of nitrogen. Ammonium nitrate and ammonium sulfate gave the highest yields in both tests. On sandy loam soil, ammonium phosphate-sulfate gave significantly smaller yield increases, while anhydrous ammonia gave smaller increases on a loam soil. Applications of superphosphate again had no significant effect on yields.

The combined averages of the four tests in 1954-55 show that ammonium nitrate and ammonium sulfate gave the largest overall yield increases, followed by urea, ammonium phosphate-sulfate and anhydrous ammonia.

Lynch, D. L., and Cotnoir, Jr., L. J. THE INFLUENCE OF CLAY MINERALS ON THE BREAKDOWN OF CERTAIN ORGANIC SUBSTRATES. Soil Sci. Soc. Amer. Proc. 20: 367-370. 1956.

Carbohydrate materials, crop residues and proteinaceous materials were degraded by soil microflora in the presence and absence of clay minerals. The carbohydrates used included two cellulose dextrins differing in solubility and chain length, polysaccharides from sweet corn, starch dextrin, and hydroxyethylcellulose. The crop residues used were alfalfa meal, soybean leaf meal, soybean meal, and oat straw. Casein and gelatin were utilized as proteinaceous materials. A yeast nucleinic acid and a pectin (RX_3) also were used in this study.

A calcium bentonite, an illite, and a calcium kaolinite of pH 8.0 respectively, were added to the substrates in a mineral medium and phosphate buffer. Carbon dioxide was collected in standard Baryta's solution and determined by titration. The activity of the enzymes, cellulase and hemicellulase was determined in the presence and absence of two clay minerals using an Ostwald viscometer to measure the time of efflux.

The association of the substrate with bentonitic clays resulted in an attenuated breakdown of many of these substrates. Very little protective influence was noted with the illitic and the kaolinitic clays. However, the kind and complexity of the substrate influenced the amount of breakdown; the simpler compounds were broken down more completely than the complex. The cellulose dextrins, casein, gelatin, soybean leaf meal, alfalfa meal, soybean meal and oat straw all evolved less carbon dioxide in the presence of calcium bentonite than in its absence.

MacLean, A. J. INFLUENCE OF ADDITIONS OF LIME TO SOILS ON THE AVAILABILITY OF POTASSIUM AND OTHER CATIONS FOR ALFALFA. Canadian Jour. of Agr. Sci. 36(3): 213-220. May-June 1956.

In a greenhouse experiment comprising six soils, varying in reaction from about pH 5.5 to 6.0, additions of calcium hydroxide had no appreciable effect on exchangeable potassium but resulted in a slight reduction in water-soluble potassium in some of the soils. With successive increases in the pH of the soils and associated increases in exchangeable and water-soluble calcium, there was an appreciable reduction in exchangeable magnesium.

The potassium and magnesium contents of alfalfa grown on the soils tended to decrease with liming, whereas the calcium content increased. Increase in yield resulting from addition of potassium fertilizer was usually accompanied by a decrease in the sum of cations in the plants.

MacLean, A. A., Doyle, J. J., and Hamlyn, F. G. FERTILITY STUDIES ON SOME NEW BRUNSWICK SOILS. II. SOIL POTASSIUM SUPPLY AS SHOWN BY GREENHOUSE AND CHEMICAL TESTS. Canad. Jour. Agr. Sci. 37: 29-33. 1957.

Fertility investigations were conducted on samples of surface soil collected from six farms on each of five soil types occurring in the Saint John River Valley. The effect of applied potassium on the yield and potassium content of ladino clover served as a basis for evaluating several chemical methods used in assessing the potassium status of different soils.

Applied potassium resulted in significant increases in yield on two soils and in the potassium content of the crop on all soils. The higher the potassium content of the crop grown without potassium fertilizer, the lower was the increase in yield from applied potassium.

Soil potassium values, as determined by four chemical methods, varied significantly between soil types. Correlation coefficients relating uptake of potassium by ladino clover with the values obtained by the four methods were significant at the 1 percent level.

Mann, H. H., and Barnes, T. W. THE PERMANENCE OF ORGANIC MATTER ADDED TO SOIL. Jour. Agr. Sci. 48(2): 160-163. 1956.

Four course organic manures were used. They were barnyard manure; sewage sludge; a compost made from straw and green weed material on the farm, activated with barnyard manure; and similarly a compost activated with sewage sludge. These were applied about February in each year at two rates, i.e., 15 tons and 30 tons per acre in time for the first crop of the season. The barnyard manure was more active than the other three materials. Compost made from sewage sludge was the least active of the materials used.

Martin, J. P., Helmkamp, G. K., and Ervin, J. O. EFFECT OF BROMIDE FROM A SOIL FUMIGANT AND FROM $CaBr_2$ ON GROWTH AND CHEMICAL COMPOSITION OF CITRUS PLANTS. Soil Sci. Soc. Amer. Proc. 20: 209-212. 1956.

A study was made to determine the influence of soil Br from $CaBr_2$ treatments or from preplanting fumigation of soil with ethylene dibromide on growth and chemical composition of citrus plants. The treatments did not affect the percentages of Ca, Mg, K, Na, or P in the plants. Preplanting fumigation with ethylene dibromide or treatment with $CaBr_2$ reduced growth of citrus seedlings, whereas fumigation with ethylene dichioride or treatment with $CaCl_2$ exerted little or no influence. In one soil, citrus leaf Br concentrations of 0.17, 0.33, 0.40, 1.3, and 1.8% were associated with 12, 22, 31, 57, and 90% reduction in growth, respectively. In two soils certain citrus leaf Br concentrations originating either from soil $CaBr_2$ applications or pretreatment of the soil with ethylene dibromide fumigant were associated with comparable growth retardation.

Carrot and lima bean plants grown for comparison were much more tolerant to Br than were citrus plants. A leaf concentration of 2.5% Br did not reduce growth of carrots. Lima beans tolerated 1.5% or more leaf Br, while 0.2% was sufficient to reduce growth of citrus plants.

McLean, E. O. FACTORS AFFECTING YIELDS AND UPTAKE OF PHOSPHORUS BY DIFFERENT CROPS: II. ROCK PHOSPHATE AND SUPERPHOSPHATE, SEPARATE AND IN COMBINATION, UNDER EXTENDED CROPPING. Soil Sci. 82: 181-192. 1956.

A greenhouse experiment was conducted to compose the response of crops to rock phosphate, superphosphate, and a combination of the two, and to compare the effects of these crops when incorporated into the soil on succeeding crops. Phosphates were applied only at the beginning of the investigations at rates of 1,500 pounds of rock phosphate, 900 pounds of superphosphate, and 750 pounds of rock and 450 pounds of superphosphate per 2 million pounds of soil. The initial cropping included alfalfa, oats, buckwheat, and uncropped, with the crops incorporated into the soil. This was followed by extended cropping with oats, the test crop which was removed.

In the initial cropping, rock phosphate was not very effective as a source of phosphorus for oats and alfalfa. In both crops the superphosphate produced a significant or near significant increase in yield over the combination of rock and superphosphate. Buckwheat responded considerably better to rock phosphate than the other crops. Other results are also given.

Pratt, P. F., Simon, R. H., and Volk, G. W. RELEASE OF POTASSIUM FROM NONEXCHANGEABLE FORMS IN RELATION TO SOIL REACTION. Soil Sci. Soc. Amer. Proc. 20: 190-192. 1956.

Alternate incubations at various pH values and extractions with 0.5 N HCl for a Crosby soil indicated an increase in K release from nonexchangeable forms with increase in pH. Incubations of samples of the same soil with various cations in the exchange complex indicated higher K release from nonexchangeable forms with Ca rather than H as the exchangeable cation. Samples of six soils were extracted with $AlCl_3$ or with HOAc and then incubated in the moist after removal of excess salts and the addition of various quantities of lime. There was about 50% less K release with the $AlCl_3$ treated soils than with the HOAc treated soils. With the $AlCl_3$ soils there was no change in K release with increase in pH. In the HOAc treated soils there was a tendency for K release to increase with increase in pH.

Ragland, J. L., and Seay, W. A. THE EFFECTS OF EXCHANGEABLE CALCIUM ON THE RETENTION AND FIXATION OF PHOSPHORUS BY CLAY FRACTIONS OF SOIL. Soil Sci. Soc. Amer. Proc. 21: 261-264. 1957.

Laboratory studies were made of the phosphorus retaining and fixing properties of four Kentucky soils. The soils studied were: Armour, Pembroke, and Memphis silt loams, and Loradale silty clay loam. All work was done with the clay fraction of the soils. The effect of percent calcium saturation of the clay, rate of phosphorus application, and initial saturating cation were studied. Retained phosphorus was considered to be that portion of the added phosphorus removed from a water solution by the clay separate. Fixed phosphorus was considered to be that portion of the retained phosphorus not recovered from the clay separate by extraction with 0.005N H_2SO_4. Radioactive phosphorus was used in the experiment. Phosphorus retention and fixation were determined by a solution counting technique.

With a rate of 100 parts of P_2O_5 per million parts of clay, phosphorus retention and fixation by the four initially acid saturated clay fractions increased as the percent calcium saturation of the clay was increased. No sizeable increase occurred until the clay separates were about 60% calcium saturated. When phosphorus was applied to Loradale clay separate at a rate of 800 or more parts of P_2O_5 per million parts of clay, fixation decreased with increasing percentages of calcium saturation. This would indicate that fixation studies should be carried out with rates of phosphorus application comparable with those used on field crops if laboratory results are to be extrapolated to field conditions.

Initially aluminum saturated clay separate retained much more of the added phosphorus but fixed no more of it than initially acid saturated clay separate.

Phosphorus fixation by clay separates with "natural" base saturation decreased with increasing pH, whereas fixation by initially acid saturated clay separate increased or remained unchanged with increasing pH. This may indicate that fixation studies made with initially acid saturated clay separates are not accurate indications of fixation as it occurs under natural soil conditions.

Scarsbrook, C. E., and Cope, J. T., Jr. FERTILITY REQUIREMENTS OF RUNNER PEANUTS IN SOUTHEASTERN ALABAMA. Ala. Poly. Inst. Agr. Expt. Sta. Bull. 302. December 1956.

Applications of nitrogen fertilizers on runner peanuts do not affect yields or quality. The need for phosphorus fertilizer for peanuts has decreased in recent years. The small amount of phosphorus required by peanuts is apparently supplied by residual phosphorus from past fertilization practices. A response from phosphorus can be expected on lands that have hot been previously well fertilized. Peanuts usually respond to 30 to 50 pounds of potash on soils testing medium to low in soil potash. High rates of potash may lower the quality of peanuts if sufficient lime is not present. Calcium is one of the most limiting factors in peanut production in Alabama. A source of calcium should be added when the calcium carbonate equivalent falls below the range of 600 to 800 pounds per acre. The application of calcium in the pegging area on soils deficient in calcium increases both yield and quality of peanuts. Poppy peanuts indicate the need for calcium

Scholl, W., Wallace, H. M., and Fox, E. I. GRANULAR MIXED FERTILIZER USE, 1954-55. Agr. and Food Chem. 5: 20-27. 1957.

The consumption of granular mixed fertilizers in the continental United States in the year ended June 30, 1955, amounted to 1,331,524 tons or 8.8% of the total quantity of all mixed fertilizers. The East North Central and West North Central regions together accounted for 69.2% of the total tonnage of granular mixtures, as compared with only 0.9% for the South Atlantic region. Among the individual states, Iowa used the largest quantity (180,112 tons) of granular mixtures.

Shapiro, R. E., Taylor, G. S., and Volk, G. W. SOIL OXYGEN CONTENTS AND ION UPTAKE BY CORN. Soil Sci. Soc. Amer. Proc. 20: 193-197. 1956.

A method was developed to maintain the oxygen content of soil air in pots at different levels by means of a controlled diffusion technique.

The yield of plant tops and roots was reduced by low soil oxygen contents. Decreasing the soil oxygen contents also reduced the percentages of K, Mg, P, and N found in the plant tops, while the percentage values for these elements in the roots increased. These results indicated that low soil oxygen may affect the translocation of ions from the roots to the tops more than absorption of these elements from the soil.

Elements other than potassium, particularly phosphorus, were of importance in explaining reduced yields with low soil oxygen contents.

When gaseous diffusion between soil and the atmosphere was eliminated after a period of normal plant growth, the percentages of K and Ca in the tops were reduced while the percentages of these elements increased in the roots. Again, the data indicated a translocation effect resulting from poor aeration.

Smith, J. A., and Matthews, B. C. RELEASE OF POTASSIUM BY 18 ONTARIO SOILS DURING CONTINUOUS CROPPING IN THE GREENHOUSE. Canad. Jour. Agr. Sci. 37: 1-10. 1957.

Eighteen Ontario soils were ranked according to their capacity to supply potassium from non-exchangeable forms to eight successive crops of alfalfa. This capacity was found to be closely related to the percentage of clay in the soils. Potassium content of the alfalfa and total uptake of potassium were highly correlated with both exchangeable soil potassium and release of potassium from non-exchangeable forms. Exchangeable potassium levels below 100 lb. per acre gave low yields and potassium content of the crop. Excessively high exchangeable potassium levels resulted in luxury consumption of potassium by the crop or in fixation by the soil. In soils at or near their equilibrium exchangeable potassium levels, i. e., not heavily fertilized, there was a close relationship between potassium-supplying power and the exchangeable potassium content measured either before cropping commenced or at the end of the cropping period.

Smith, J. A. YIELD-OF-NUTRIENT CURVES AND AVAILABILITY OF PHOSPHORUS AND POTASSIUM IN BURFORD LOAM IN THE GREENHOUSE. Canad. Jour. Agr. Sci., Vol. 36, No. 5, pp. 339-348. Sept.-Oct. 1956.

An oat crop followed by a red clover-orchard grass mixture was grown in the greenhouse on a Burford loam soil with increasing rates of added phosphorus and potassium.

Light "starter" applications of phosphorus and potassium placed near the seed were sufficient for maximum yield of oat plants. Yields of hay were increased by additional "soil" treatments of these two nutrients. The total uptake of phosphorus or potassium increased with each additional increment of these elements except for the "starter" treatment. Close linear relationships were observed between the amounts of phosphorus and potassium removed by cropping and the amounts applied as fertilizer.

Extrapolation of these linear regressions to the points of intersection on the X-axes gave soil "P-values" and "K-values" in terms of the added fertilizer materials. The regression coefficients provided an estimation of the percentage utilization of the fertilizer applied.

The soil was shown to have a considerable capacity to fix added phosphorus and to release non-exchangeable potassium. It is suggested that these two phenomena help to explain the lack of consistent and significant response of this soil to applied phosphorus and potassium in the field.

Smith, R. L., and Wallace, A. INFLUENCE OF NITROGEN FERTILIZATION CATION CONCENTRATION, AND ROOT CATION-EXCHANGE CAPACITY ON CALCIUM AND POTASSIUM UPTAKE BY PLANTS. Soil Sci. 82: 165-172. 1956.

Varying the Ca/K in the nutrient solution from 1/10 to ∞ at constant Ca had only a minor effect on Ca45 absorption by beans and barley. There was evidence of a slight stimulation of K on Ca45 uptake for some concentrations. Decreasing Ca concentration in the nutrient solution from 10^{-1} to 10^{-2} N and also from 10^{-2} to 10^{-3} N resulted in a decrease of Ca45 uptake which was approximately equal to the square root of the concentration difference.

Varying the K/Ca in the nutrient solution from ∞ to 1/10 at constant K had a depressing effect on K42 uptake by beans and barley. There was no evidence of a Ca stimulation of K uptake. For low-salt roots, decreasing K concentration by a factor of 10 reduced the K42 absorption by about 1/5 but for high-salt roots the reduction was by about 1/10 or directly related to the concentration differences.

Spencer, W. F. DISTRIBUTION AND AVAILABILITY OF PHOSPHATES ADDED TO A LAKELAND FINE SAND. Soil Sci. Soc. Amer. Proc. 21: 141-144. 1957.

Analyses of soil samples obtained from the surface 6 inches of experimental plots located on the Citrus Experiment Station at Lake Alfred, Florida, indicated that a high percentage of the phosphorus added as superphosphate was not found in this zone. In order to study the distribution of this "leached" phosphorus, soil samples were obtained at various depths from the surface to 7 feet within the citrus-root feeding zone. Analyses of these samples for total, adsorbed (NH_4F extractable) and acid-soluble (0.1N HCl extractable) phosphorus indicated the following:

1. Essentially all of the added phosphorus was retained within the citrus-root feeding zone, even though it may have been leached from the surface 6 inches of soil. The greatest accumulation occurred within the 12- to 36-inch subsoil zone; however, phosphorus had leached to a depth of at least 7 feet in some cases.
2. Separation of the phosphorus into adsorbed and acid-soluble fractions indicated that the major portion of the added phosphorus was retained in an adsorbed or NH_4F extractable form.

The availability to citrus seedlings of the phosphorus accumulated in both the surface and subsoil was measured by the A value technique utilizing radio-phosphorus. The data indicated that the phosphorus accumulated in the subsoil was as available as that phosphorus which was retained in the surface 6 inches of soil. A good correlation was obtained between A value phosphorus and the amount of phosphorus extracted from the soils with NH_4F.

Stojanovic, B. J., and Broadbent, F. E. IMMOBILIZATION AND MINERALIZATION RATES OF NITROGEN DURING DECOMPOSITION OF PLANT RESIDUES IN SOIL. Soil Sci. Soc. Amer. Proc. 20: 213-218.

Two well drained New York soils of the Gray-Brown Podzolic group, Ontario loam and Honeoye silt loam, were incubated under controlled temperature, moisture, and aeration. Soils were treated with either wheat straw or corn leaves, and inorganic nitrogen (ammonia or nitrate). Samples were taken at 2, 4, 6, 10 and 18-day intervals. Ammonia and nitrate nitrogen were determined. Enriched nitrogen was employed for computing mineralization and immobilization rates.

Recovery data indicate that rapid immobilization took place when wheat straw was added in combination with either ammonia or nitrate nitrogen. Immobilization of added ammonia occurred when corn leaves were added with ammonia nitrogen. Reduction of nitrate was negligible in treatments where corn leaves plus nitrate nitrogen were added.

Mineralization and immobilization data indicate that a substantial amount of nitrogen is turned over in the presence of available energy material. It has been further observed that immobilization is of significant magnitude even in the decomposition of a high nitrogen-containing material such as corn leaves. For example, in the case of wheat straw plus nitrate, during the 2 to 6-day interval, the equivalent of 56 pounds of nitrogen per acre per day was immobilized. Maximum turn over occurred in the 0 to 2-day interval with corn leaves. In the latter case the maximum microbial activity would be attained earlier since the energy material was more available.

Stotzky, G., Martin, W. P., and Mortensen, J. L. CERTAIN EFFECTS OF CROP RESIDUE AND FUMIGANT APPLICATIONS ON THE DECOMPOSITION OF AN OHIO MUCK SOIL. Soil Sci. Soc. Amer. Proc. 20: 392-396. 1956.

A Rifle peat, treated with a 10 ton application of young rye and wheat straw and fumigated with nine chemical mixtures, was incubated for 15 weeks with alternate wetting and drying. A second experiment was conducted in which evolved CO_2 was collected from the same muck which had been similarly treated.

After an incubation period of 18 days, CO_2 equivalent to 45% of the carbon added as rye, was evolved by the muck soil. The rate of evolution of CO_2 was increased by CIPC treatment and slightly reduced by other fumigant treatments. There was a significant increase in the percentage of carbon of the peat during the course of the 15 week incubation, with a significantly larger carbon percentage being noted in the soils treated with Dow W-85 and CRAG 974. Mineralization of nitrogen was significantly increased as a result of rye, Shell CPB-55, Dow W-85, and CRAG 974 treatments and significantly reduced by straw and CIPC additions. The activity index of lignin was significantly decreased by CIPC and all residue treatments. The apparent polyuronide content was significantly increased by rye, Shell CPB-55, CRAG 974, and CIPC. The use of certain herbicides, fungicides, and insecticides appears to have little practical value in reducing the subsidence of organic soils.

Stevenson, F. J. ISOLATION AND IDENTIFICATION OF SOME AMINO COMPOUNDS IN SOILS. Soil Sci. Soc. Amer. Proc. 20: 201-204. 1956.

An isolation experiment was conducted to obtain sufficient amounts of all of the amino acids in a soil hydrolysate to permit their identification. This was done by a selective separation on a large column of Dowex 50, in which elution was carried out by hydrochloric acid. The identification of the various compounds was accomplished by the application of specific tests, by paper partition chromatography, and by ion exchange chromatography on a sodium column of Dowex 50, using the procedure of Moore and Stein.

Twenty-nine ninhydrin-reacting compounds were identified positively as products of hydrolysis of soils, one compound was identified tentatively, and three others were isolated but not characterized. In addition to the compounds previously verified, the following were confirmed: cysteic acid, N-acetyl-D-glucosamine, methionine sulfone, a, ϵ-diaminopimelic acid, a-amino-n-butyric acid, methionine sulfoxide, methionine, cystine, and ornithine. A discussion is given concerning the natural occurrence of these compounds in soils.

Taper, C. E., Collins, W. B., Murray, H. R., and Kennedy, J. E. MAGNESIUM, CALCIUM, AND BORON NUTRITION OF THE STRAWBERRY IN RELATION TO BLACK ROOT DISEASE. Canad. Jour. Agr. Sci. 37: 167-173. 1957.

An experiment was conducted in order to study the effects of all possible combinations of three different concentrations of the elements magnesium, calcium, and boron upon strawberry plants of the variety Senator Dunlap growing in sand culture. The effect of these treatments on the contents of the three elements was determined by spectographic analysis.

Increasing the concentration of magnesium in the culture solution tended to increase the accumulation of magnesium and to decrease the accumulation of calcium by the plants. Increasing the concentration of boron in the culture solution tended to increase the accumulation of boron by the plants and to decrease their yield of fruit. All plants growing in a culture solution containing 0.5 p. p. m. of boron developed both a foliar symptom characteristic of boron toxicity, namely, a marginal chlorosis of the leaves, and certain symptoms characteristic of strawberry black root disease, namely, gradually extending necrotic areas upon the crowns and roots. The fact that the foliar chlorosis symptomatic of boron toxicity in strawberry appeared upon plants supplied with a relatively low concentration of boron is confirmation of the low boron requirement of the strawberry. The fact that the typical foliar symptom of boron toxicity was in all cases accompanied by certain symptoms characteristic of black root disease, namely necrosis of crown and roots, seems to suggest that the latter, in this instance, were also symptomatic of boron toxicity.

Terman, G. L., and Seatz, L. F. CROP RESPONSE TO METAPHOSPHATE FERTILIZERS. Soil Sci. Soc. Amer. Proc. 20: 375-378. 1956.

Results of tests with metaphosphate fertilizers were summarized for the 1936-54 period. These included 1,092 tests with calcium metaphosphate (CMP) and 175 tests with potassium metaphosphate (KMP) on acid to neutral soils, and 82 tests with CMP on alkaline soils. Only results of tests were included in which a significant yield response to phosphorus was obtained. On acid to netural soils, CMP compared favorably with concentrated superphosphate (CSP) on corn, small grain, forage, cotton, and tobacco crops but was slightly inferior on potato and vegetable crops. KMP was also an excellent source of phosphorus for corn, cotton, small grain, and forage crops. Liming acid soils had the same effect in increasing yields with CMP as with CSP. There was no appreciable advantage from the standpoint of crop production in grinding CMP finer than to pass a 10-mesh screen. CMP was, in general, a satisfactory source of phosphorus for alfalfa and other hay grown on calcareous soils but was usually poorer than CSP for potatoes, sugar beets, and spring-sown small grain.

Thomas, Winifred. EFFECT OF PLANT POPULATION AND RATE OF FERTILIZER NITROGEN ON AVERAGE WEIGHT OF EARS AND YIELD OF CORN IN THE SOUTH. Agron. Jour. 48(5): 228-230. May 1956.

On Dewey silt loam (ph 6.8, high in available P and exchangeable K) average ear weight of corn decreased from 7.6 ounces at plant population of 6,000 to 6.4 and 4.8 for populations of 12,000 and 18,000, respectively. N fertilizer significantly increased corn yield, but with little or no increase above 40 pounds per acre with any plant population. The 12,000-populations showed overall increases, including no nitrogen treatment, of 10.3 and 13.8 bushels per acre over the 18,000 and 6,000 plant populations.

Thorne, Gillian N., and Watson, D. J. FIELD EXPERIMENTS ON UPTAKE OF NITROGEN FROM LEAF SPRAYS BY SUGAR BEET. Jour. Agri. Sci. (47)1: 12-21. Feb. 1956.

When the leaves of sugar-beet crops were sprayed on six occasions in late September and early October with 100 gallons per acre of a 3 percent solution of ammonium nitrate or equivalent urea, in two experiments about 70 percent of the nitrogen was recovered in the plants in mid-October, compared with 40 percent recovered from applications of the same amounts of fertilizer to the soil at the same times. In a third experiment the recovery from similar sprayings with urea solution was less than 40 percent, but very little nitrogen was absorbed from soil dressings, so that the difference between the recoveries from spray and soil applications was nearly the same as in the other experiments.

Nitrogen percent of dry matter in all parts of the plants was increased by the sprays. More than half of the nitrogen absorbed from the sprays was in the leaf laminae, and the remainder was equally divided between petioles (including crowns) and roots.

Viets, F. G., Jr., Boawn, L. C., and Crawford, C. L. THE EFFECT OF NITROGEN AND TYPES OF NITROGEN CARRIER ON PLANT UPTAKE OF INDIGENOUS AND APPLIED ZINC. Soil Sci. Soc. Amer. Proc. 21: 197-201. 1957.

Zinc uptake from Ritzville fine sandy loam in pots was measured by successive cropping with two crops of milo, four cuttings of Ladino clover and a final crop of milo. The zinc treatments consisted of 4 pounds zinc (as sulfate) per acre applied initially, and none. The 4 nitrogen treatments in factorial combination with the zinc treatments applied to each of the first 2 crops of milo were none, and 200 pounds nitrogen per acre as $(NH_4)_2SO_4$, NH_4NO_3, and $NaNO_3$, respectively. No nitrogen was applied to the clover;

200 pounds nitrogen per acre were applied uniformly to all treatments during the growth of the final milo crop.

Significant yield increases due to zinc application were obtained on the second and third crops of milo and the first cutting of clover when $NaNO_3$ was used as a nitrogen source. A range in soil pH from 5 to 7.3 resulted depending on the nitrogen source. Zinc uptake by all crops was increased by the initial zinc application. Nitrogen application generally increased the uptake of both native and applied zinc, the effect depending on the change in pH brought about by the nitrogen carrier. $NaNO_3$ tended to decrease uptake of native zinc except on the first two crops of milo. Uptake of indigenous zinc where the soil pH had been lowered to 5 by use of $(NH_4)_2SO_4$ was equal to that obtained with 4 pounds of $ZnSO_4$ when the soil pH was raised to 7.3 using $NaNO_3$.

Multiple regression analysis of the Zn uptake data indicated that the diverse effects of nitrogen sources could be explained by shifts in soil pH and by differences in plant growth.

Only a small portion of the applied zinc was utilized by any one crop, and the utilization changed little with cropping. Zinc applied as sulfate remained available during the cropping sequence.

Wahhab, A., and Hussain, I. EFFECT OF NITROGEN ON GROWTH, QUALITY, AND YIELD OF IRRIGATED WHEAT IN WEST PAKISTAN. Agron. Jour. 49: 116-119. 1957.

Sixty pounds of nitrogen applied at seeding time gave higher yield increases on irrigated wheat than other rate or time of application. Nitrogen did not affect germination, number of spikes per head and number of kernels per spike. It increased highly significantly the number of tillers and mature heads per plant, and weight of 1,000 grains. It also increased nitrogen, moisture and potash content but decreased phosphorus and dry matter percentage. Number of kernels per head and fat and ash content were not affected.

Wahhab, A., and Bhatti, H. M. EFFECT OF VARIOUS SOURCES OF NITROGEN ON RICE PADDY YIELD. Agron. Jour. 49: 114-116. 1957.

Ammonium nitrogen gave much better rice yields than nitrate nitrogen. Calcium cyanamide and urea were also more effective than nitrate nitrogen. Nitrate nitrogen applied just before heading proved more beneficial to rice than that applied at the early stage of plant growth. Generally, ammonium sulphate increased rice yields more than the other nitrogen fertilizers tested.

Walker, T. W., Adams, A. F. R., and Orchiston, H. D. FATE OF LABELED NITRATE AND AMMONIUM NITROGEN WHEN APPLIED TO GRASS AND CLOVER GROWN SEPARATELY AND TOGETHER. Soil Sci. 81: 339-351. May 1956.

$(NH_4)_2SO_4$ and KNO_3 labeled with N_{15} were applied at various levels to grass and clover grown separately and together. The distribution of this N in tops, roots, and soil was studied.

Regardless of the plants grown, approximately 30 percent of the labeled N was lost, presumably by denitrifications. Slightly higher losses were noted from KNO_3 than from $(NH_4)_2SO_4$. In all cases some labeled N was converted into soil organic N, and where clover was grown alone, rather more was recovered from the soil than in the clover.

Clover grown alone utilized considerably less labeled N than did grass grown alone, and with increasing levels of combined N, more N was taken up and correspondingly less fixed symbiotically.

Wallace, A., and Ashcroft, R. T. AMMONIUM LIGNIN SULFONATE AS A CHELATING AGENT FOR SUPPLYING SOLUBLE IRON TO PLANTS. Soil Sci. 82: 233-236. 1956.

An Fe chelate made from a by-product of the wood pulp industry was found to be effective by soil application in supplying iron to plants and in correcting lime-induced chlorosis in soybeans. Although this substance did have the ability to chelate Fe at alkaline pH values, it required considerably longer application rates to give the same results as the most effective of the polyamine-polyacetate chelating agents.

Wallace, A., and Ashcroft, R. T. CORRELATION OF PHOSPHORUS AND MAGNESIUM CONTENTS OF PLANTS GROWN IN SYNTHETIC ION-EXCHANGE RESINS. Agron. Jour. 48(5): 219-222. May 1956.

In studies of rough lemon, avacado, barley, and bush beans, little evidence was found to indicate that increasing Mg level resulted in increased content of P in plants, although this was true in some crops having a low Mg requirement, and only at a high P level.

Wear, John I. BORON REQUIREMENT FOR CRIMSON CLOVER SEED PRODUCTION, ITS ACCUMULATION IN SOILS, AND RESIDUAL EFFECTS ON SENSITIVE CROPS. Agron. Jour. 48(3): 132-134. Mar. 1956.

After each of 4 annual applications on Alabama soils, boron did not accumulate in the surface 12 inches of coarse-textured soils, but did in fine-textured soils.

Crimson clover seed yield increases were highest with the first 10 pound rate of borax per year as coarse-textured soils. Four annual 30-pound applications on crimson clover were not toxic to soybeans and cotton following the clover.

Wear, J. I. BORON REQUIREMENTS OF CROPS IN ALABAMA. Ala. Agr. Expt. Sta. Bul. 305. March 1957.

A small continuous supply of boron is required by plants. This supply can be furnished by Alabama soils in most cases. Some plants, however, require larger amounts than the soil can provide. Therefore, boron must be added to the soil for adequate growth and seed production.

Boron-deficient plants can be recognized usually by internal or external symptoms. An exception is crimson clover, seed production of which can be drastically reduced without any noticeable deficiency symptoms.

Wear, J. I. EFFECT OF SOIL pH AND CALCIUM ON UPTAKE OF ZINC BY PLANTS. Soil Sci. 81(4): 311-315. April 1956.

$CaCO_3$, $CaSO_4$, and Na_2CO_3 were incorporated in a Norfolk sandy loam at various rates to measure the effects of pH and calcium on the uptake of zinc by an indicator in the greenhouse.

An application of 2000 pounds of $CaCO_3$ per acre considerably decreased the zinc content of sorghum. The pH of the soil was increased from 5.7 to 6.6, and the calcium content of the plant was increased from 0.78 to 1.09 percent. Higher rates of $CaCO_3$ further decreased the zinc content to some degree. Sodium carbonate also reduced the zinc uptake as the pH of the soil increased. The effect of pH on the uptake of zinc by the plant is a pH effect and not a calcium effect.

Weaver, H. A., and Pearson, R. W. INFLUENCE OF NITROGEN FERTILIZATION AND PLANT POPULATION DENSITY ON EVAPOTRANSPIRATION BY SUDAN GRASS. Soil Sci. 81: 443-451. June 1956.

Evapotranspiration rates by Sudan grass grown in Lloyd clay at two levels of soil moisture, three levels of plant density, and two levels of nitrogen were observed for a 1-month period, during which the plants grew from a height of about 2 inches to maturity for hay.

Evapotranspiration rate was affected very little by nitrogen level, but it was influenced appreciably by plant population level. Water-use efficiency, however, was greatly increased by application of nitrogen, which produced a relatively heavy growth of grass without appreciable change in total evapotranspiration. An over-all linear increase in efficiency with population increase also occurred.

Evapotranspiration rates were appreciably greater for all treatments and periods at the high level of soil moisture at the low level.

Wells, C. G., Seay, W. A., Bortner, C. E., and Valleau, W. D. THE EFFECTS OF PHOSPHORUS AND ORGANIC MATTER ON THE CONCENTRATION OF CERTAIN DECOMPOSITION PRODUCTS OF CYANAMID IN TOBACCO PLANTBEDS. Soil Sci. Soc. Amer. Proc. 21: 192-196. 1957.

Field experiments were conducted to determine the effects of superphosphate and organic matter in preventing the accumulation of toxic residues where Cyanamid was used for weed control in tobacco plantbeds on heavy silt loam soils of central Kentucky. Toxic materials or conditions in some cases following treatment with Cyanamid resulted in stunted tobacco seedlings or even death. Soil conditions where seedling injury was noted include soil pH above 8 and ammonium-N concentration exceeding 350 ppm. of soil at seeding time (about April 1). Three-fourths pound per square yard of 20% superphosphate applied with the Cyanamid decreased soil pH and ammonium-N concentration, resulting in improved plant growth. Organic matter decreased soil pH and ammonium-N content but not until May which is too late for seeding.

In laboratory studies ammonium ions from the decomposition of Cyanamid were more readily leached from the soil when superphosphate or other materials supplying cations had been added. Leaching ammonium-N from the soil resulted in improved plant growth particularly when superphosphate had been used. In greenhouse studies ammonium-N in soil was found to be toxic to tobacco seedlings, particularly at high soil pH as occurs when Cyanamid (equivalent to 70% calcium hydroxide) is applied to soil in sufficient quantity to act as a weed control agent.

White, R. F., Kempthorne, O., Black, C. A., and Webb, J. R. FERTILIZER EVALUATION: II. ESTIMATION OF AVAILABILITY COEFFICIENTS. Soil Sci. Soc. Amer. Proc. 20: 179-186. 1956.

Response curves produced when plants are grown on soils treated with different rates of fertilizers are used as the basis for estimating the ratio of the availability coefficient of a nutrient in one fertilizer to that in another. A least squares method is described and illustrated for fitting each of three types of response curves. Concurrent linear response curves are illustrated by data on yield of phosphorus. Parallel linear response curves for log response against log rate of application are illustrated by data on content of radioactive phosphorus. Concurrent Mitscherlich curves with the same initial and limiting responses but different rates of increase are illustrated by data on yield of corn grain.

Younts, S. E., and York, E. T. EFFECT OF DEEP PLACEMENT OF FERTILIZER AND LIME ON YIELD AND ROOT ACTIVITY OF CORN AND CRIMSON CLOVER. Soil Sci. 82: 147-155. 1956.

Fertilizer and lime were distributed throughout the soil at specified depths to 24 inches to study their influence on root activity and yields of corn and crimson clover. Root activity was measured by absorption of Ca^{45} and removal of water.

Near surface applications of fertilizer tended to promote development and activity of corn roots at lower depths early in the growing season, but as the plants approached maturity roots were more active where distributions were made down to 24 inches. Nitrogen tended to suppress deep root activity regardless of its depth of distribution.

Corn yields were unaffected by fertilizer distributions, whereas clover yields were increased with increased depth of distribution. More K was absorbed by both corn and clover as the fertilizer was mixed with larger volumes of soil.

Bourget, S. J., and Kemp, J. G. WET SIEVING APPARATUS FOR STABILITY ANALYSIS OF SOIL AGGREGATES. Canad. Jour. Agr. Sci. 37: 60. 1957.

The design of van Bavel's wet sieving apparatus for soil aggregate stability analysis has been modified. A different sieve arrangement and a deeper tub are advantageous. Principles of operation are given for the modified unit.

Emerson, W. W. A COMPARISON BETWEEN THE MODE OF ACTION OF ORGANIC MATTER AND SYNTHETIC POLYMERS IN STABILIZING SOIL CRUMBS. Jour. Agr. Sci. 47(3): 350-353. May 1956.

Synthetic soil crumbs stabilized by the addition of small quantities of a polymer, and natural soil crumbs from old grassland, was extracted with neutral sodium pyrophosphate and alkali and the strengths of the crumbs compared before and after extraction, using the sodium saturation technique. Three polymers were used: polyvinyl alcohol (a non-ionic polymer), sodium alginate, and a vinyl acetate-maleic anhydride co-polymer (Vama), the latter both carboxylated polymers. Pyrophosphate was able to displace the carboxylated polymers from the synthetic crumbs, but not the stabilizing fraction of the organic matter from the grassland crumbs. 0.5 N-NaOH produced a much greater reduction on the strength of the alginate treated crumbs compared with Vama crumbs, which is attributed to the weaker hydrogen bonds formed by the former. Prolonged leaching with alkali removed a considerable part of the stabilizing organic matter in the grassland crumbs. Neither method of extraction affected the stability of the polyvinyl alcohol crumbs.

It is concluded that the grassland crumbs are stabilized by the formation of interlamellar complexes with the clay in the crumbs, and probably that the substance forming the complexes is a polymer and contains amino-groups.

Evidence is also given that phosphate ions and the carboxylated polymers are attached in the same manner to the edges of the clay crystals.

Chesters, G., Attoe, O. J., and Allen, O. N. SOIL AGGREGATION IN RELATION TO VARIOUS SOIL CONSTITUENTS. Soil Sci. Soc. Amer. Proc. 21: 272-277. 1957.

The relative importance of diverse factors affecting aggregation in four Wisconsin soil types was studied by multiple regression analyses. Single and combined effects of pH and contents of organic matter, microbial gum, clay, and free iron oxide were considered.

In general the most important single factor was the microbial gum. However, in the Kewaunee soil which has a relatively high content of clay and iron oxide, the iron oxide was of prime importance in aggregate formation. In all the soils, iron oxide showed a marked effect on aggregation with a tendency to be more important in the smaller aggregate size range. The effect of clay, however, was very small with the exception of the high clay soil (often >30% clay), in which its effect was only exceeded by that of the free iron oxide. In the multiple correlation analysis the effect of organic matter was considered separately from that of microbial gums. By this statistical analysis only a slight positive relationship existed between organic matter and soil aggregation, i.e., the effect of organic matter was conditioned largely by its content of microbial gum; pH 6.5 was optimum. No relationship existed between soil aggregation and the rate of decomposition of organic matter as measured by CO_2 evolution from the soil.

Grossman, R. B., and Cline, M. G. FRAGIPAN HORIZONS IN NEW YORK SOILS: II. RELATIONSHIPS BETWEEN RIGIDITY AND PARTICLE SIZE DISTRIBUTION. Soil Sci. Soc. Amer. Proc. 21: 322-325. 1957.

Twenty-four fragipan horizons were studied to determine the relationships between rigidity and particle size distribution. Objective consistence measurements, using relatively unaltered clods, were related to various textural components. Fourteen of the horizons were relatively sandy (sandy loams and light loams) and 10 were silty (silt loams).

The measurement of consistence involved: shaping clods by hand into rough cylinders approximately 40 mm. long and 25 mm. in diameter; encasing the upper and lower surfaces of each clod in plaster of paris to form smooth, parallel bearing surfaces; and crushing the clods by the slow application of an axial stress and recording the maximum stress withstood per unit of cross-sectional area over which the stress was applied. Mean values of 25 to 40 clods from each horizon were used in analyses of the data.

Rigidity was found to be highly correlated with percent total clay. It was concluded that clay was a principle bonding agent among primary particles, that very fine sand or silt may be equally effective as a matrix within which such clay bonding may occur, and that clay may act either as a bonding agent or as an agent of structural development and consequent weakness, depending upon its amount and distribution within the soil mass. The data do not suggest a special role for ultra-fine clay.

Knox, E. G. FRAGIPAN HORIZONS IN NEW YORK SOILS: III. THE BASIS OF RIGIDITY. Soil Sci. Soc. Amer. Proc. 21: 326-330. 1957.

Four fragipan horizons from Orange County, New York soils were studied to determine what materials or mechanisms are responsible for the strength of fragipans. Very fine-grained material apparently holding the sand and silt particles together was identified as illite by optical and X-ray diffraction methods. Experiments based on selective removal and destruction of possible bonding materials indicate that illite is responsible for a major part of the strength of the more typical fragipans studied, and that both illite and colloidal silica are involved in the strength of an extreme pan. Comparison of the strength of artificial briquets and natural clods further indicated that an important part of the strength of the pans studied is due to illite. It was shown that fragipans typically have high bulk density. The effectiveness of illite as a binding material in fragipans may be due to high bulk density, lack of effective structure, and special distribution of the clay.

Drainage

Dreibelbis, F. R., and McGuinness, J. L. PLANT-NUTRIENT LOSSES IN LYSIMETER PERCOLATES. Agron. Jour. 49: 523-527. 1957.

Plant nutrient losses in the percolates from monolith lysimeters over the period 1940-1955 were analyzed for variables of soil type, farming practice and amounts of percolate. Under permanent grass the depth of rooting was associated with percolation amounts while farming practice governed the amount of nutrient losses. Under rotation crops the tighter Keene soils showed greater nutrient losses than the more permeable Muskingum soils. Nutrient losses under different farming practice showed a mixed response.

Hantush, M. S. ANALYSIS OF DATA FROM PUMPING TESTS IN LEAKY AQUIFERS. Amer. Geophys. Union Trans. 37: 702-714. 1956.

Graphical methods are outlined for determining the coefficients of transmissibility, storage, and leakage of a effectively infinite leaky artesian aquifer. The procedure is based on the theory, developed by Hantush and Jacob, of the nonsteady flow toward a steadily discharging well from an infinite leaky aquifer. Applications of these methods are illustrated by treating data from the Roswell artesian basin in New Mexico.

Humphrey, R. R., and Shaw, R. J. PAVED DRAINAGE BASINS AS A SOURCE OF WATER FOR LIVESTOCK OR GAME. Jour. Range Mgmt. 10: 59-62. 1957.

A triangular area containing 4,300 square feet was paved with asphalt in a 14-inch rainfall zone in southern Arizona. Rainwater from this area has been stored in an adjacent cistern. As a source of water for livestock this type of construction appears to be feasible where other cheaper or more dependable sources of water are not available.

Blaney, H. F. EVAPO-TRANSPIRATION MEASUREMENTS IN WESTERN UNITED STATES. Publication no. 38 de l'Association Internationale d'Hydrologie (assemblee generale de Rome, tome III).

This paper describes field methods for determining water use and presents results of measurements of evapo-transpiration by irrigated crops and natural vegetation in western United States. It describes a method for determining evapo-transpiration in areas where no measurements are available. Briefly, the procedure is to correlate existing evapo-transpiration data with monthly temperature, monthly percentages of yearly daytime hours, and growing period. The coefficients so developed for different kinds of vegetation are used to transpose the evapo-transpiration data for a given area to other areas for which only climatological data are available by means of a formula, $U = KF$, where U = Consumptive use (or evapo-transpiration) for a period; K = Empirical coefficient; and F = Consumptive use factor.

Bloodworth, M. E., Burleson, C. A., and Cowley, W. R. EFFECT OF IRRIGATION DIFFERENTIALS AND PLANTING DATES ON THE GROWTH, YIELD AND FIBER CHARACTERISTICS OF COTTON IN THE LOWER RIO GRANDE VALLEY. Tex. Agr. Expt. Sta. Prog. Rpt. 1866. 1956.

An irrigation differential-planting date experiment on cotton was conducted at the Lower Rio Grande Valley Experiment Station during the 1955 season. Timing of irrigation water applications to coincide with critical stages of cotton plant growth demand was found to be very important. Cotton often is over-irrigated while young and under-irrigated during fruiting and maturity stages. In these experiments, small quantities of irrigation water produced yields comparable with yields produced with greater amounts of water. Irrigation water applied before the bloom stage depressed cotton growth in both date-of-planting tests and the yields were not significantly increased.

The daily water use by cotton plants was dependent on both soil and aerial environments, stage of plant growth and the amount of available water in the soil. Water use by cotton varied over a wide range throughout the season. More efficient use of water and more rapid growth of the cotton plants were made by plants in the March 15 (late) planting. Maximum use and demand for soil moisture by cotton plants started about the time or immediately prior to flowering and continued until most of the bolls were mature and a great number of them had opened.

Bouyoucos, G. J. IMPROVED SOIL MOISTURE METER. Agr. Engr. 37(4): 261-262. Apr. 1956.

When, how much, and how deep to irrigate are basic questions to which the irrigator requires reliable answers each time he applies irrigation water to cropland. The author in this article reviews latest improvements in a soil moisture meter and related equipment widely used in recent years as a scientific guide to irrigation.

Carreker, J. R., and Huston, W. E. DESIGNING SPRINKLER IRRIGATION SYSTEMS. Agr. Ext. Serv., Univ. of Georgia College of Agr. Bull. 588. May 1955.

Sprinkler irrigation is a new practice that is rapidly gaining prominence on Georgia farms. Through irrigation, farmers have the means of obtaining high level production every year. The vast water resources within the state can be utilized to eliminate the effects of short droughts each year.

The design of a sprinkler irrigation system can greatly influence the success of its use. This bulletin shows the importance of properly designing such systems and serves as a guide for designing, financing and purchasing irrigation systems.

Criddle, W. D., Davis, S., Pair, C. H., and Shockley, D. G. METHODS FOR EVALUATING IRRIGATION SYSTEMS. Agr. Handbook No. 82, Soil Conserv. Serv., U. S. Dept. Agr. Apr. 1956.

Irrigation engineers, Soil Conservation Service technicians, and other professional people working in irrigation should find the evaluation methods described here useful in helping farmers attain greater efficiency in irrigation. These evaluations will also lead to better design criteria for local soils, crops, and climatic conditions.

Dreibelbis, F. R., and Youker, R. E. SOIL MOISTURE DISTRIBUTION ON IRRIGATED CORN PLOTS. Soil Sci. Soc. Amer. Proc. 20: 292-295. 1956.

An account of the soil-moisture distribution obtained by fiberglas-gypsum blocks on irrigated plots is presented as an aid in evaluating the needs of water for irrigation on field corn and sweet corn in Southeastern Ohio. Soil moisture depletion was determined from moisture changes in the Keene silt loam and presented as total depletion in the 0 to 7-, 0 to 10-, 0 to 12-, 0 to 14-, and 0 to 18-inch depths on sweet corn for various periods during the growing season in 1954. The data for 1954 indicate that on this soil type the 0 to 7-inch depth would suffice as a criterion for irrigation requirements up to July 14, and the 0 to 12-inch depth from July 15 to Sept. 17.

A summary of the data to evaluate the quantitative needs of water for irrigation purposes is presented for the Keene and Muskingum soils. Data on the moisture content at saturation, at field capacity, and at the wilting point are given in inches water for the 0 to 7-, 0 to 10-, 0 to 12-, 0 to 14-, 0 to 18-, and 0 to 24-inch soil depths, together with the amount of water necessary to raise the moisture content to field capacity from the 1/2 available water level. From this level in the 0 to 24-inch depth on the Keene silt loam, 2.76 inches water are needed to raise the moisture content to field capacity, while 2.40 inches are required on the Muskingum silt loam. In the 0 to 7-inch depths, the values are 0.81 and 0.73 inches respectively for the same soil types.

Garton, J. E. DETERMINING IRRIGATION SYSTEM CAPACITY. Agr. Engr. 37(8): 543. Aug. 1956.

This article explains by means of nomographs how to determine the capacity of irrigation systems.

Haise, H. R., Donnan, W. W., Phelan, J. T., Lawhon, L. F., and Shockley, D. G. THE USE OF CYLINDER INFILTROMETERS TO DETERMINE THE INTAKE CHARACTERISTICS OF IRRIGATED SOILS. USDA, ARS 41-7. May 1956.

This is a description of standardized procedure recommended for using cylinder infiltrometers for measurement of intake rates of water into soil as a basis for the design of farm irrigation systems and the development of recommendations for water application practices in the Western States.

Hall, W. A. ESTIMATING IRRIGATION BORDER FLOW. Agr. Engr. 37(4): 263-265. Apr. 1956.

A practical method for predicting the rate of water advance down an irrigation border simplifies design of border-strip checks.

Hoglund, C. R., Kidder, E. H., and Vary, K. A. ECONOMICS OF IRRIGATING IN MICHIGAN. Quar. Bull. Mich. Agr. Expt. Sta., Mich. State Univ. of Agr. and Applied Sci., E. Lansing, Vol. 39, No. 2, pp. 208-229. Nov. 1956.

Detailed information on investments, expenses, and income were obtained from a limited number of farmers during the early part of 1956. This information was used in making an economic appraisal of irrigation on farms of different sizes. An economic analysis was also made of irrigation research data from the departments of agricultural engineering, animal husbandry, farm crops, and horticulture.

Hutchins, W. A. IRRIGATION WATER RIGHTS IN CALIFORNIA. Cir. 452, Calif. Agr. Expt. Sta. Ext. Serv.

California farmers who use irrigation water--or plan to use it--need to know something about water rights. The subject is not a simple one; for there are several kinds of water rights in this state, and each is subject to a somewhat different set of laws. This circular explains, in layman's language, the principles set forth in these laws and in laws on water wells and dams.

Myers, L. E., Jr. IRRIGATION EFFICIENCY AND MOSQUITO PRODUCTION. Mosquito News, Vol. 16, No. 2, June 1956.

The relationship between mosquito production and the efficiency of irrigation and water use practices offers us the opportunity to develop a powerful weapon for use in combatting irrigation-caused mosquito problems. This opportunity is not in itself, however, an answer to our problems. We will obtain the answers we need only through intelligent planning, wholehearted cooperation, and hard work.

Nelson, C. E., and Robins, J. S. NITROGEN UPTAKE BY LADINO CLOVER-ORCHARD-GRASS PASTURE UNDER IRRIGATION AS INFLUENCED BY MOISTURE, NITROGEN FERTILIZATION AND CLIPPING TREATMENTS. Agron. Jour. 49: 72-74. 1957.

On shallow Ephrata fine sandy loam soil, the nitrogen uptake in the grass and clover was greatest from mid-summer irrigation at 7- to 11-day frequency and 12-inch clipping height than a longer frequency and less height. Total nitrogen uptake increased in the grass and decreased in the clover with increased nitrogen fertilizer rates. The clover supplied 99 pounds of nitrogen per acre to the grass when no fertilizer nitrogen was applied. The nitrogen in the grass, other than from fertilizer nitrogen, increased in relationship to clover yields.

Painter, R. H. DIRECTION CONTROL IN DEEP-WELL DRILLING. Agr. Engr. 37(8): 548-549. Aug. 1956.

Methods of measuring deflection during drilling in deep water well holes at regular intervals keeps the hole straight, thereby reducing pump maintenance, increasing pump efficiency, and insuring against curves that restrict pipe entrance.

Pillsbury, A. F., Weeks, L. O., Spencer, J. R., and Reeve, R. C. DISCHARGE OF TILE DRAINAGE SYSTEMS IN AN IRRIGATED AREA OF CALIFORNIA. Amer. Geophys. Union Trans. 37: 474-476. 1957.

Measurements of discharge from the drains in the Coachella Valley of California have been plotted, and a simple equation has been developed, to give maximum discharge in terms of drainage area or length of tile. It has not been possible as yet to relate the coefficients or exponents involved to differences in soil characteristics or irrigation practices, but as more information is developed this may be possible.

Good data on which to base the design capacity of tile drains in irrigated areas have been lacking. The 'drainage coefficient' used in humid areas is not applicable, and the ponded condition, which would permit rational calculation of discharge (Kirkham, 1949) is not reached. The information here developed is presented as a first step towards solution of the problem.

Pratt, P. F., Goulben, B., and Harding, R. B. CHANGES IN ORGANIC CARBON AND NITROGEN IN AN IRRIGATED SOIL DURING 28 YEARS OF DIFFERENTIAL FERTILIZATION. Soil Sci. Soc. Amer. Proc. 21: 215-219. 1957.

A study was made of the changes in organic C and N and in the ratio of C:N in the soil of a long-term fertility trial with citrus at the University of California Citrus Experiment Station, Riverside, during 28 years of irrigation and differential fertilization, from 1927 to 1955.

All changes in organic C and N and ratio of C:N in the soil were in the surface 0 to 6 inches. Check plots that received no fertilizers or organic materials contained about the same quantities of organic C and N in 1955 as in 1927. Treatment with urea and triple superphosphate did not increase the organic C and N in the soil. The $(NH_4)_2SO_4$ treatment increased the organic C and N, probably as a result of extreme acidification of the soil. The $Ca(NO_3)_2$ treatment increased the organic C but not the organic N. Cover crops increased the organic C and N a small but statistically significant amount. Mineral N had no effect on the increases in C and N from the cover crops or from any of the added organic materials.

There were accumulations of KCl-extractable and fixed NH_4 in the soil of acidified plots but not in soil of pH near neutrality.

The accumulation of organic C and N in the soil increased with increase in the rate of application of manure, the highest rate of application approximately tripling the organic C and N. The accumulations of C and N resulting from applications of alfalfa hay, bean straw, or cereal straw were not significantly higher statistically than those from the cover-crop treatment, and were much lower than those resulting from the application of equivalent weights of organic materials as manure.

Pratt, P. F., and Harding, R. B. DECREASES IN EXCHANGEABLE MAGNESIUM IN AN IRRIGATED SOIL DURING 28 YEARS OF DIFFERENTIAL FERTILIZATION. Agron. Jour. 49: 419-421. 1957.

Decreases in exchangeable Mg in the soil of a long-term fertility trial with oranges during 28 years of irrigation and fertilization were calculated by subtracting the values found for samples taken in 1955 from those for samples taken in 1927. These decreases were smallest where manure was used as a source of nitrogen, and largest where $NaNO_3$ and gypsum were added throughout the experiment. Decreases in exchangeable Mg were highly correlated with the amounts of salts added as fertilizers or soil amendments. Sodium nitrate and $Ca(NO_3)_2$ were equally effective in decreasing exchangeable Mg, and about doubly as effective as urea.

Richards, L. A., Bower, C. A., and Fireman, M. TESTS FOR SALINITY AND SODIUM STATUS OF SOIL AND OF IRRIGATION WATER. Cir. No. 982, U. S. Dept. Agr. July 1956.

This circular gives tests for estimating the agricultural significance of soluble salt and exchangeable sodium in soil and the quality of irrigation water. The tests are intended primarily for professional agricultural workers and are designed to give a maximum of information for a minimum of effort. Soils and waters will be encountered, therefore, for which the information obtained by the tests will be inadequate or indecisive. For example, the exchangeable sodium test is indecisive for soils with extremely high salinity and also for soils with extremely low salinity and high sodium.

Robins, J. S., Nelson, C. E., and Domingo, C. E. 1954 IRRIGATION AND NITROGEN FERTILIZATION EXPERIMENTS ON SUGAR BEETS IN THE COLUMBIA BASIN. Wash. Agr. Expt. Sta. Cir. 278. Dec. 1955.

This report summarizes results obtained in 1954 from studies on the characteristics of certain Columbia Basin Project soils and the effects of excess irrigation water on sugar beets. Sugar beet yields were markedly reduced by overirrigation early in the growing season. Reductions of 15 to 20 percent were experienced as a result of adding two to four times as much water as the soil would retain in each irrigation.

Robins, J. S., Nelson, C. E., and Domingo, C. E. SOME EFFECTS OF EXCESS WATER APPLICATION ON UTILIZATION OF APPLIED NITROGEN BY SUGAR BEETS. Jour. Amer. Soc. Sugar Beet Technologists, pp. 180-188, Vol. IX, No. 2, July 1956.

This study was designed to determine the effects of application of excess irrigation water on utilization of nitrogen and the resulting effects upon sugar beet yields, sugar content, and nitrogen status. Application of irrigation water in excess of that storable in the root zone early in the growing season materially reduced sugar beet yields. Sugar content at harvest was considerably higher on treatments receiving early excess water applications than on the control irrigation treatments. The differences were greatest at high nitrogen rates.

Stippler, H. H. SPRINKLER IRRIGATION IN THE PACIFIC NORTHWEST. Agr. Inform. Bull. 166. U. S. Dept. Agr. Nov. 1956.

The study reported here supplies information on costs of operating sprinkler systems, the factors that affect costs, the labor requirements, and the variations in costs caused by different designs of systems and methods of operation. Detailed records were taken in several areas of the Pacific Northwest--the Willamette Valley, Oreg., central Washington, and southwestern Idaho. In the Willamette Valley, an area of relatively high rainfall, sprinklers are used primarily to irrigate vegetables, specialty crops, and pasture. The average capacity of systems was 8 gallons per minute per acre; average discharge per sprinkler 10.3 gallons per minute; and rate of irrigation (with spacing of 40 x 60 feet) 0.43 inch per hour. The average system irrigated 34 acres and had 1,317 feet of 5-inch mainline and 1,433 feet of 3-inch lateral pipe. Systems were used an average of 1,079 hours per season. Average investment per system was about $2,900, or $116 per acre; costs of operation averaged about $2 per acre-inch of water. Cost of operating an efficiently designed system for a vegetable farm was $21.53 per acre irrigated; for a dairy farm, $24.83. In the two more arid areas, sprinkler irrigation is used largely where soil depth, topography, or water supply does not permit gravity irrigation. Investment per acre in these areas was similar to that in the Willamette Valley. Costs of operating an efficiently designed system on a fruit farm was $40.63 per acre irrigated.

Woudt, B. D. V. OBSERVATIONS ON THE EFFICIENCY OF SUB-IRRIGATION IN HEAVY SOILS. Canad. Jour. Agr. Sci. 37: 588-592. 1956.

The interest in sub-irrigation has lately been revived because of its successful application in a number of sandy soils, peats, and some heavy soils in the Netherlands. In heavy soils the difficulty is enountered that water extraction by roots tends to exceed moisture replenishment from a water table. This is related to the slow capillary movement in heavy soils and to the fact that the rate of this movement declines progressively as the soil-moisture content is further depleted by the roots. The rate can be maintained where the soil is kept moist by occasional rain storms during the period of sub-irrigation. This point is illustrated by experimental work at Rukuhia. Measurement of pasture production at various depths of water table and under varying climatic conditions showed that sub-irrigation can be quite successful if supplemented by rain; in the absence of rain sub-irrigation was quite inefficient. Some observations have been referred to which show that substantial amounts of water can be derived from a water table, even in heavy soils, where active roots penetrate close to it, but an undue rise in the level of the water table should be averted in that case.

Erosion Control

Beadley, R. P., and Meyer, L. D. NEW TERRACE CONSTRUCTION TECHNIQUE. Agr. Engin. 38: 32-36. 1957.

Terraces that are easier to farm and that lower farm operating costs by reducing the point-row area on cropland and other shortcomings of conventional terracing are made possible by a new technique developed known as "parallelized terracing." The method used requires more time than a conventional system and the construction costs are somewhat greater due to the lateral movement of soil. However, these terrace systems are easier to farm, and the cost of the farming operations is less. Over a period of time, the greater initial cost will be offset by the reduced cost of farming with the system.

Chepil, W. S. FACTORS THAT INFLUENCE CLOD STRUCTURE AND ERODIBILITY OF SOIL BY WIND: V. ORGANIC MATTER AT VARIOUS STAGES OF DECOMPOSITION. Soil Sci. 80(5): 413-421. Nov. 1955.

Decomposing vegetative matter in the form of wheat straw or green alfalfa mixed into the soil increased the proportion of water-stable aggregates greater than 0.84 mm. in diameter, decreased the proportion of water-stable particles smaller than 0.02 mm., slightly increased the proportion of dry soil clods greater than 0.84 mm., and slightly decreased erodibility of soil by wind. The effects were more pronounced with larger quantities of added vegetative matter.

The results were entirely different after the vegetative matter was decomposed (2 to 5 years after treatment). The decomposed vegetative matter or the products resulting from decomposition had little or no influence on the proportion of water-stable aggregates greater than 0.84 mm., but increased the proportion of medium-sized water-stable aggregates, decreased the proportion of water-stable particles or aggregates less than 0.02 mm., decreased soil cloddiness, and increased erodibility by wind. It was concluded that far greater protection from wind erosion would be derived from maintenance of vegetative materials on top of the ground than from mixing them into the soil to increase soil aggregation during the initial stage of their decomposition.

Chepil, W. S. INFLUENCE OF MOISTURE ON ERODIBILITY OF SOIL BY WIND. Soil Sci. Soc. Amer. Proc. 20: 288-292. 1956.

This study was undertaken to determine the general influence and the specific quantities of moisture that soils must have to resist wind.

Erodibility by wind was about the same for soil that was oven-dried or air-dried in sun or in shade when moisture did not exceed one-third of the 15-atmosphere percentage. Beyond this range of moisture a distinct decrease in erodibility was manifested. Erodibility decreased rather slowly at first, then more rapidly with each successive increment of moisture added, reaching zero, on the average, at about 15-atmosphere percentage. Increasing the moisture even slightly above the 15-atmosphere percentage required a relatively great increase in wind velocity to produce movement of soil.

It was shown that erodibility by wind is a function of the cohesive force of adsorbed water films surrounding the soil particles. Equations were derived indicating the relationships between cohesive force due to adsorbed water films, quantity of adsorbed water, and erodibility by wind.

Chepil, W. S. SEDIMENTARY CHARACTERISTICS OF DUST STORMS: I. SORTING OF WIND-ERODED SOIL MATERIAL. Amer. Jour. Sci. 255: 12-22. 1957.

Sorting of soil materials by the wind is an intricate phenomenon. The most distinct feature in the whole sorting process was found to be the peak diameter of the saltating grains. Fractions larger than the peak diameter tend to remain in the wind-eroded fields, and particles smaller than this diameter tend to be deflated and carried far through the atmosphere. Depending on soil class, from 31 to 78 percent of particles smaller than 0.1 mm in diameter contained in the wind-transported soil fraction are deflated by a single windstorm. Silt generally is more readily deflated than sand or clay. Wind erosion has caused little change in texture of loess soils but has tended to remove the fine constituents from the coarser-textured soils, leaving the sand behind. This sorting process if continued even for a day or two adds considerably to the general sandiness of the affected areas and to consequent irreparable depletion of soil productivity.

Chepil, W. S., and Woodruff, N. P. SEDIMENTARY CHARACTERISTICS OF DUST STORMS: II. VISIBILITY AND DUST CONCENTRATION. Amer. Jour. Sci. 255: 104-114. February 1957.

Analysis of some dust storms in Kansas and Colorado during 1954 and 1955 indicates a relationship between visibility and atmospheric dust concentration when rules of Houghton are followed. Visibility varies inversely as some power of concentration, and concentration varies inversely as a certain power of height. The quantity of soil removed from any region for any storm or period of time can be estimated.

Chepil, W. S. SEDIMENTARY CHARACTERISTICS OF DUST STORMS: III. COMPOSITION OF SUSPENDED DUST. Amer. Jour. Sci. 255: 206-213. 1957.

Wind-blown dust varied widely in its composition depending on the composition of eroded soil, the year of measurement, and the distance and height of transport. The composition of the dust was like the composition of many samples of loess. The size distribution of dust and of coarser materials transported at any height or deposited anywhere after any single windstorm was characterized by a single peak diameter of the discrete particles and by arms on each side of the peak falling off independently of each other at some constant rate. The peak diameter varied from one graded material to another, depending on the physical nature of the soil, distance and height of transport, and possibly the velocity of the wind.

Duley, F. L. THE EFFECT OF A SYNTHETIC SOIL CONDITIONER (HPAN) ON INTAKE, RUNOFF, AND EROSION. Soil Sci. Soc. Amer. Proc. 20: 420-422. 1956.

Five plots were established to determine the effect of a soil conditioner (HPAN) at three rates of application on rainfall intake, runoff, and erosion. The plots were on Sharpsburg silty clay loam having a slope of 8.5%. The results obtained over a period of 30 months indicate that HPAN has increased the size of soil aggregates and has increased intake and reduced runoff and erosion as compared with untreated soil. A straw mulch applied at the rate of 2.5 tons per acre was more effective in reducing runoff and erosion than any of the HPAN treatments.

Smith, D. D. TIME STUDY OF PARALLEL TERRACES. Agr. Engin. 37(5): 342-345. May 1956.

Parallel terraces were applied successfully to fields of claypan soils with land slopes of 6 percent or less. Point-row areas for conventional terraces averaged 30 percent of total area. Paralleling of the terraces reduced the point-row areas by 70 percent. Point-row areas resulted in an average row length 53 percent of that possible had parallel terraces been used instead of conventional. Average rate of travel in farming parallel terraced land was 16 percent greater than on conventionally terraced land. The saving in farming time by paralleling averaged about 24 percent for corn and soybeans.

Woodburn, R., and Kozachyn, J. A STUDY OF RELATIVE ERODIBILITY OF A GROUP OF MISSISSIPPI GULLY SOILS. Amer. Geophys. Union Trans. 37: 749-753. 1956.

In attempting to correlate watershed characteristics with reservoir sediment in a 1951 study, unexplained variation was found. It was thought that basic differences in soil erodibility between watersheds might account for a part of this variation. Accordingly, studies were made to determine erodibility difference between soils, using several methods and using gully soils, free of vegetative influences. No absolute measure of erodibility seemed available. A laboratory rainmaker was used on cores of undisturbed soil and compared with a wet sieving aggregate stability method on pulverized soil. Both were contrasted with natural rain splash losses on 9-inch diameter cores of undisturbed soil.

Soil losses by laboratory splash technique generally compared very well with results by the aggregate stability method. The results from these two methods did not compare well with splash erosion caused by 29 months of actual rain except from the sandy material. The high percentage of natural rain at intensities below the critical value for detaching cemented soils was thought responsible.

It appears that soils vary widely in their resistance to erosion as determined by any method. It further appears that relative erodibility may be varied depending upon the choice of methods of applying the erosion producing energy. Although no generally accepted standard method of assessing erodibility is yet available it is encouraging that different soils show widely different erosion rates. Therefore there is a possibility of deriving a method adequate to express erosion susceptibility differences. Loose sandy material from different geologic sources had about the same erosion potential regardless of method of evaluation. In general splash erosion increased with increase in sand content of the soil material. Aggregate stability decreased with increasing sand content.

Woodruff, N. P. WIND-BLOWN SOIL ABRASIVE INJURIES TO WINTER WHEAT PLANTS. Agron. Jour. 48: 499-504. 1956.

Winter wheat plants were given fall and spring exposures to blowing soil in a wind tunnel. Average yields, weights of plant material, and number of heads for spring treatments were 46.4, 29.4, and 23.9% less, respectively, than fall treatments. Heading and ripening of grain was delayed 1 week to 10 days on severely exposed plants. The total amount of soil striking a plant was more important in depressing products of plant growth than was the length of time between exposures. The plants were shown to have remarkable recovery powers if given water after severe abrasive injury.

Cropping Systems

Brown, W. G., and Oveson, M. M. PROFITABILITY OF FIELD CROP ROTATIONS IN UMATILLA COUNTY. Oregon State College Agr. Expt. Sta. Cir. of Inform. 573. March 1957.

Average yearly profit margins over cash operating costs per acre of cropland have been estimated for the 22 crop rotations, and are presented. Yearly total income per acre for each rotation was obtained by multiplying the average annual yield by the1955 price received by Oregon farmers.

Daniel, H. A., Cox, M. B., and Elwell, H. M. STUBBLE MULCH AND OTHER CULTURAL PRACTICES FOR MOISTURE CONSERVATION AND WHEAT PRODUCTION AT THE WHEATLAND CONSERVATION EXPERIMENT STATION, CHEROKEE, OKLAHOMA, 1942-1951. Prod. Res. Rpt. No. 6, Agr. Res. Serv., U. S. Dept. Agr. October 1956.

Stubble mulch and other cultural practices for moisture conservation and wheat production were studied on deep, permeable, and fertile soil, with rolling topography, at the Wheatland Conservation Experiment Station in Alfalfa County, near Cherokee, Okla., from 1942 to 1951. The experiment was designed to devise means of reducing runoff water and conserving moisture for wheat production. Investigations consisted of a comparison of different methods of seedbed preparation, including both continuous and rotation tillage.

Continuous tillage experiments were designed to evaluate effectiveness of plowing, listing, basin listing, and stubble-mulch tillage practices on terraced and unterraced land. Rotation methods compared the effectiveness of a 3-year sequence of one-way plowing, basin listing, and stubble-mulch tillage on contour cultivated land. Large sweeps seemed to be the best tool for stubble-mulch tillage.

Runoff water from continuous tillage practices was least from mulched land and greatest from listed, where all cultivation was conducted up and down the slope. Both listing and basin listing reduced runoff water when listing followed the contour. Where a combination of terraces and contour cultivation was used, the average annual amount of runoff water was reduced 35.4 percent. Mulches and rough surfaces also conserved water on rotation tillage areas. However, there was little or no difference in moisture content stored in the soil under different methods of tillage, except that plots listed on the contour contained more moisture at seeding time than those moldboard plowed.

Terraces and contour cultivation only increased the yield of wheat an average of 1.1 bushels per acre. The highest yield was produced on plowed land and the lowest on mulched, in continuous tillage experiments. Where rotation tillage was used, the highest yield of wheat was obtained from one-way plowed land and the lowest on mulched. Weeds and foot-rot or disease were severe competition to wheat on mulched land, but they were not a serious problem where the tillage was rotated.

Free, G. R. INVESTIGATIONS OF TILLAGE FOR SOIL AND WATER CONSERVATION I. A COMPARISON OF CROP YIELDS FOR CONTOUR VS. UP AND DOWNSLOPE TILLAGE. Soil Sci. Soc. Amer. Proc. 20: 427-429. 1956.

An experiment consisting of 6 sets of paired plots on a 10% slope of Honeoye silt loam in Central New York was started in 1942. Management factors such as fertilization, rotation, tillage, and crop have been the same for each pair. One plot of each pair, however, has been plowed and planted on the contour and the other up and downhill. Not only have crop yields differed significantly over the period 1942 through 1954 but the yield advantage in favor of contouring has been increasing. By 1954 the difference calculated from average regression amounted to 21.3%. Reasons for these cumulative benefits of contouring are discussed. The results of soil studies will be given in later papers of the series.

Residue Management

Fuller, W. H., Nielsen, D. R., and Miller, R. W. SOME FACTORS INFLUENCING THE UTILIZATION OF PHOSPHORUS FROM CROP RESIDUES. Soil Sci. Soc. Amer. Proc. 20: 218-224. 1956.

A large proportion of phosphorus of crop residues was found to be readily available to succeeding crops. Some of the factors that influence the rate of release of phosphorus from plant residues added to soils for use by succeeding plants were studied. They were: (a) maturity of the crop residue, (b) phosphorus content of the residue, (c) rate of application of the residues, (d) time of contact of the crop residue with the soil, (e) kind of crop residue, and (f) plant part involved. The study was conducted under greenhouse conditions in large glazed pots that held 1 kg. or more of soil.

The influence of the above factors on the utilization of phosphorus by several test crops is less pronounced in soils well supplied with available phosphorus than in soils low in available phosphorus. The rate of availability of the phosphorus of the crop residues to the test crops, ryegrass and tomato, was inversely related to the stage of growth of the residues. For example, green manures cut prior to blooming supplied plants with about as much phosphorus as did liquid H_3PO_4 fertilizer. The phosphorus of straw, on the other hand, was absorbed by plants to a lesser extent than that of the liquid H_3PO_4. The phosphorus of residues high in total phosphorus was more readily available to plants than was that of residues low in phosphorus. The threshold phosphorus content of the crop residue above which the phosphorus of the residue was not wholly immobilized by microorganisms for use in decomposition was found to be about 0.2%. Phosphorus from root residues was less readily available than that from top residues only if the residues came from fully mature plants.

Hedlin, R. A., Smith, R. E., and Leclaire, F. P. EFFECT OF CROP RESIDUES AND FERTILIZER TREATMENTS ON THE YIELD AND PROTEIN CONTENT OF WHEAT. Canad. Jour. Agr. Sci. 37: 34-40. 1957.

Results are presented showing the effect of alfalfa, grass and wheat crop residues on the yield and protein content of wheat during the 6-year period, 1948-1953.

The yield of first crop wheat after alfalfa (34.4 bu. /ac.) was greater than the yield after grass (25.6 bu.). The yields of wheat after fallow in which wheat straw residues had been incorporated were 31.4 and 32.4 bu. The second wheat crop after alfalfa (23.8 bu.) yielded more than the second crop after grass (19.4 bu.) and also than the second crop after fallow (18.4 and 16.3 bu.)

Returning wheat crop residues reduced yields. This effect was slight the first year after fallow but more pronounced the second year after fallow. The depressing effects of grass and wheat crop residues were partly offset by applications of 16-20-0 at 108 lb. per acre. Yields of the second crop of wheat after fallow were greater where sweet clover had been ploughed down in the fallow year or where the straw residues were burned.

The protein content was highest after alfalfa and where sweet clover was ploughed down in the fallow year. Protein content was low after grass breaking. Fertilizer treatments, although they increased yield, had little effect on protein content.

CROPS

General

Drinkwater, W. O., and Janes, B. E. RELATION OF POTENTIAL EVAPOTRANSPIRATION TO ENVIRONMENT AND KIND OF PLANT. Amer. Geophys. Union Trans. 38: 524-528. 1957.

The purpose of this investigation was to establish relationships between potential evapotranspiration and several elements of weather, potential evapotranspiration as influenced by the surroundings and irrigation of the surroundings, and potential evapotranspiration of Kentucky bluegrass, sweet corn, and celery. High correlations were found between measured potential evapotranspiration (PE) of bluegrass and open-pan evaporation, atmometer evaporation, average temperature, solar radiation, and duration of sunshine when data were grouped into between-rain periods. When the same data were grouped into seven-day periods, relatively low correlations were obtained. Uniform surroundings, watered daily, were found to reduce measured PE of bluegrass 23.2 percent below bluegrass in non-uniform surroundings which were not watered. Measured PE exceeded evapotranspiration computed by the Thornthwaite empirical formula by 10 to 70 percent and appeared more closely associated with amount of rainfall than with mean temperature. Water use by sweet corn was found to be 22.2 percent higher than use by bluegrass. Although the surrounding area of celery was watered each day, PE was 11.0 percent greater than that of bluegrass, the surrounding area of which was not watered. When compared with PE of bluegrass which received daily irrigation of surroundings, water use by celery was 36.8 percent greater.

Johnson, I. J., and El Banna, A. S. EFFECTIVENESS OF SUCCESSIVE CYCLES OF PHENOTYPIC RECURRENT SELECTION IN SWEETCLOVER. Agron. Jour. 49: 120-125. 1957.

The effectiveness of phenotypic recurrent selection was measured in four successive cycles on first year growth of biennial yellow sweetclover. Results from this study show that changes per cycle, as measured in terms of variances and population means, were greater for a plant character with high heritability than for a character with a lower heritability. The progress made suggests that phenotypic recurrent selection may be an effective means for modifying an unselected population to improve uniformity in growth type and plant vigor.

Keating, F. E., and Mathews, O. R. SOIL AND CROP STUDIES AT THE BIG SPRING (TEXAS) FIELD STATION. USDA Prod. Res. Rept. No. 1 in Coop. with the Tex. Agr. Expt. Station. Mar. 1957.

This report gives results of experiments in crop production at Big Spring, Tex., for the period 1916-53, inclusive.

Cotton and the grain and forage sorghums were the most productive and dependable crops. Cowpeas were the best adapted leguminous hay crop. Sudan grass was dependable and was a valuable pasture crop. The yields when harvested for hay were only a little more than half as high as the yields of forage sorghums. Peanuts produced fairly good average yields, but were less dependable than the other crops mentioned.

Fall or early-winter plowing was superior to spring tillage for all crops. Fall listing seemed to be slightly less productive than fall plowing, but listing was a cheaper operation and provided better erosion control. Much of the reduction in yield resulting from spring tillage could be avoided by starting spring cultivation in late March or early April.

Early-spring surface tillage of land to be lister-planted was necessary for best yields on lister-planted land.

Fall plowing and subsoiling to a total depth of 16 to 18 inches produced slightly higher yields than ordinary fall plowing of all crops except milo. The increase was not enough to compensate for the greater cost for any crop except cotton. The yield of cotton subsoiled land was exceeded by that of cotton lister-planted on ordinary fall plowing.

Summer fallowing produced the highest yield of most crops, but in no case was the increase great enough to make the practice profitable.

Sequence studies showed that yields of crops on cowpea land were generally higher than yields following cotton or sorghum.

Commercial fertilizers did not produce significant increases in the yields of milo or cotton during the 6 years (1948-53) that experiments were carried on.

Soil-moisture studies show that only a small part of the precipitation for the fallow period is stored in the soil. Fallow stored less than an inch more water than fall-plowed milo land. Land being fallowed lost much of the water in the first foot-section during prolonged drought periods. Losses below the first foot-section were very small.

Correlations were made between climatic factors and yields of milo and cotton. Correlations between annual precipitation and yield were higher for both crops than correlations involving shorter periods. The highest correlation for an individual month was that between April rainfall and milo yields.

Temperatures during June, July, and August were negatively associated with yield. Evaporation was also negatively correlated with yield, but the correlations were not so high as those for temperature. Wind velocity was not significantly correlated with the yields of milo or cotton. August weather had more effect on yields of milo and cotton than did the weather for any other single month.

Variety, time of seeding, and plant-spacing recommendations are made on the basis of results from cooperative experiments.

Cropping systems should be built around the most productive and dependable crops, cotton and sorghums. Adapted varieties, planted at the optimum time and rate under the best methods of tillage preparation, are essential to highest production. Best utilization of the sorghum crops appears to be through livestock. Acreage of crops other than cash crops can be regulated according to the needs of the livestock.

Martin, J. P., Baines, R. C., and Ervin, J. O. INFLUENCE OF SOIL FUMIGATION FOR CITRUS REPLANTS ON THE FUNGUS POPULATION OF THE SOIL. Soil Sci. Soc. Amer. Proc. 21: 163-166. 1957.

A study was made of the influence of soil fumigation, prior to replanting citrus trees, on the fungus population of the soil. Fumigants used included D-D, CS_2, chloropicrin, ethylene dibromide, and Vapam. It was found, in general, that after marked reduction or near destruction of the fungus populations of the soils, especially of the subsoils, fungi again became established but represented relatively few species in comparison with those in untreated soils. Numbers remained relatively low in some soils or attained higher magnitudes than in the nonfumigated soils in other plots. Additional species returned with time, but even after 2 or 3 years the populations were still markedly affected in many soils. *Trichoderma viride* was stimulated by fumigation treatment much more often than other species. Other fungi returning as dominant species in one or more soils included: *Acrostalagmus sp.*, *Aspergillus nidulans*, *Aspergillus niger*, *Aspergillus ochraceus*, *Aspergillus sydowi*, *Fusarium solani*, *Fusarium sp.*, *Gliocladium penicilloides*, *Myrothecium verrucaria*, *Penicillium nigricans*, *Penicillium restrictum*, *Penicillium vinaceum*, *Pullularia pullulans*, *Pyrenochaeta sp.*, *Sclerotium sp.*, *Sepedonium chrysospermum*, *Spicaria sp.*, *Stemphylium consortiale*, *Torula sp.*, and *Volutella sp.*

Field Crops

Bertrand, A. R., and Kohnke, H. SUBSOIL CONDITIONS AND THEIR EFFECTS ON OXYGEN SUPPLY AND THE GROWTH OF CORN ROOTS. Soil Sci. Soc. Amer. Proc. 21: 135-140. 1957.

The effects of subsoil density, fertility, and moisture content on soil aeration and root growth are reported. A factorial experiment having two levels each of subsoil compaction, fertility, and moisture was conducted.

Oxygen diffusion rates in the subsoil were studied by two methods. Oxidation-reduction potentials were determined.

Corn roots did not penetrate a subsoil compacted to a bulk density of 1.5 g. per cc., but they grew profusely in subsoil with a bulk density of 1.2 g. per cc.

Quantitative information was obtained on the rates of oxygen diffusion in the subsoil. Oxygen diffusion was slower in dense subsoils than in loose subsoils. High moisture content intensified the restricting effects of dense subsoils on oxygen diffusion rates and root growth. Subsoil fertilization increased corn root growth in loose soils.

Plant growth was not correlated with oxidation-reduction potentials within the limits found, but was correlated with gaseous diffusion through the subsoil.

Oxygen diffusion rates which limit root growth are suggested.

Cooper, C. S., Hyder, D. N., Petersen, R. G., and Sneva, F. A. THE CONSTITUENT DIFFERENTIAL METHOD OF ESTIMATING SPECIES COMPOSITION IN MIXED HAY. Agron. Jour. 49: 190-193. 1957.

A method is presented for determining the species composition by weight of a two-component forage mixture when the two components contain different concentrations of a given constituent. It consists of measuring the constituent concentration of a large sample from each plot and the species components from small samples taken at random from plots treated alike. Species composition of the large sample is then computed using appropriate formulae. The use of dry matter, calcium and crude protein to estimate botanical composition was investigated. The method was found to be more efficient than hand separation.

Hadley, H. H. AN ANALYSIS OF VARIATION IN HEIGHT IN SORGHUM. Agron. Jour. 49: 144-147. 1957.

A statistical analysis of variation in plant height was made of material from the sorghum cross Double Dwarf White Sooner Milo X Durra P. I. 54484. The data indicated segregation of at least four independent genes with unequal effects. Significant fixable as well as environmental variation was found. Dominance was indicated but was not complete. Results and conclusions in this study derived by the method described by Mather were in close agreement with those of Quinby and Karper who used essentially Mendelian procedures.

Hanson, R. G., Ewing, E. P., and Ewing, E. C., Jr. EFFECT OF ENVIRONMENTAL FACTORS ON FIBER PROPERTIES AND YIELD OF DELTA PINE COTTON. Agron. Jour. 48: 573-581. 1956.

Fiber strength of Deltapine was significantly correlated with all climatic factors studied except minimum temperature for the period July 6 to September 13 of the years 1945 to 1955. Fiber length was correlated significantly with maximum minus minimum temperature and rainfall for the period July 6 to August 23. Line percentage was not highly correlated with any of the factors. The average yield of the cottons tested was negatively associated with rainfall in June. A stress-index based on the difference between maximum and minimum temperature and rainfall is advanced.

Harris, D. G., and van Bavel, C. H. M. ROOT RESPIRATION OF TOBACCO, CORN, AND COTTON PLANTS. Agron. Jour. 49: 182-184. 1957.

The respiration rates of tobacco, corn, and cotton roots undergo daily fluctuations with the maximum rate generally occurring about 4 p. m. Root weight appears to be the primary factor influencing the amount of respiration under favorable aeration conditions. However, the concentrations of CO_2 and O_2 in the root atmosphere influence the respiration rate.

Holmes, J. C., and Tahir, W. M. THE EFFECT OF SOME FACTORS ON GROWTH, DEVELOPMENT, AND YIELD OF WINTER WHEAT. Jour. Agr. Sci. 48: 115-123. 1956.

The effect of nitrogen level, time of nitrogen application and weed control, and their interactions on three different plant densities of winter wheat were measured. Data concerning the growth, development, and yield were examined. Plant populations of 104,000, 155,000, and 281,000 per acre produced on the average of all treatments 2,130 2,240 and 2,320 pounds per acre, respectively. An increase in nitrogen fertilizer to 200 pounds of ammonium sulphate per acre increased the grain yield of all populations. This response followed an increase in the number of tillers and an increase in the percentage of tillers producing grain. There was no significant interaction between nitrogen level and plant density. The nitrogen content of the grain increased with nitrogen level. Weed control increased the grain yield of all populations. There was a significant interaction between weed control and plant density.

Kingsley, A. F., Clagett, C. O., Klosterman, H., and Stoa, T. E. LOSS OF MINERALS FROM MATURE WHEAT AND FLAX BY SIMULATED RAIN. Agron. Jour. 49: 37-39. 1957.

Simulated rain removed relatively small amounts of minerals from ripe wheat and flax plants which had been grown under field conditions. On the other hand, considerably greater amounts of minerals were leached, under the same conditions, from ripe wheat plants grown in the greenhouse. Pot watered, greenhouse plants showed more leachable mineral elements at the ripe stage, than foilage welled wilted plants, suggesting that leaching is a continuous process.

Knoch, H. G., Ramig, R. E., Fox, R. L., and Koehler, F. E. ROOT DEVELOPMENT OF WINTER WHEAT AS INFLUENCED BY SOIL MOISTURE AND NITROGEN FERTILIZATION. Agron. Jour. 49: 20-25. 1957.

Root development of winter wheat was studied in central Nebraska. Depth of soil moisture and rate of nitrogen fertilization were variables. A dense network of roots developed in soil when soil moisture tension was above 15 atmospheres. When moisture conditions were favorable, roots were observed at a depth of 13 feet. There was evidence of moisture depletion to a depth of 8 feet. Nitrogen fertilization increased root weights and moisture utilization at all moisture levels.

Mumaw, C. R., and Weber, C. R. COMPETITION AND NATURAL SELECTION IN SOYBEAN VARIETAL COMPOSITES. Agron. Jour. 49: 154-160. 1957.

Composites of pure line varieties grown at the same location showed marked varietal changes during 5 seasons. Varieties having taller height, later maturity, more lodging and greater branching habit increased in proportion suggesting a limitation in the bulk hybrid method of plant breeding. Composites of unlike varieties exceeded the mean yield of their pure lines by more than composites of similar varieties. Seed number was more important than seed size in the yield advantage of composites. Branching types yielded more than non-branching types in composites.

Pendleton, J. W., Jackobs, J. A., Slife, F. W., and Bateman, H. P. ESTABLISHING LEGUMES IN CORN. Agron. Jour. 49: 44-48. 1957.

Alfalfa was established successfully in corn by planting the alfalfa the same day as corn. High corn yields were obtained when a 20-inch area over the corn row was kept weed free and the alfalfa between the rows was clipped. Sixty-inch rows produced 92 percent and 80-inch rows produced 80 percent as much corn grain as that produced in 40-inch rows. Lespedeza and alfalfa were the easiest legumes to establish under summer seeding condition.

Penny, L. H., and Dicke, F. F. A SINGLE GENE-PAIR CONTROLLING SEGREGATION FOR EUROPEAN CORN BORER RESISTANCE. Agron. Jour. 49: 193-196. 1957.

Ratings of leaf feeding of the European corn borer on plants in F_2 and backcross progenies from two susceptible X resistant corn crosses indicated that resistance differences were conditioned by segregation of genes at a single locus. The resistance gene was linked with the gl_7 and v_{17} genes of the resistant parent with cross-over frequencies estimated at from 31% to 37%.

Probst, A. H. PERFORMANCE OF VARIETY BLENDS IN SOYBEANS. Agron. Jour. 49: 148-150. 1957.

In general, blends of soybean varieties showed no superiority in yield over the highest yielding variety in any one year or the average of a 4-year period. There was a marked variety X season interaction on yield and in this respect blending had a stabilizing effect on yield and appears to be of importance in approaching maximum yields each year.

The latest maturing variety in a blend matured earlier than the same variety in pure culture.

Rennie, D. A. VARIATIONS IN PERCENTAGE PHOSPHORUS AND PROTEIN CONTENT OF WHEAT, AS INDUCED BY FERTILIZER TREATMENT, SOIL TYPE, AND SEASON. Canadian Jour. Agr. Sci. 36: 491-504. 1956.

The data obtained from some 30 radiophosphorus field experiments on wheat were examined with a view to ascertaining the effects of nitrogen and phosphorus fertilization on percentage phosphorus in the grain and straw, and protein content of the grain.

The percentage phosphorus in the grain was significantly reduced as nitrogen applications were increased while phosphorus fertilization had no effect. Grain grown on stubble land contained consistently higher percentages of phosphorus than that on fallow due conceivably to a deficiency of available nitrogen in the stubble land. In general, the effect of soil type or climate caused greater variations in percentage phosphorus in the grain than fertilizer treatments. No statistical relationship existed between grain yield and percentage phosphorus. It is suggested that variations in available nitrogen in the soil may be responsible for variations in phosphorus percentage in the grain, both between soil type and on the same soils in different seasons.

Rodger, J. B. A., Williams, G. G., and Davis, R. L. A RAPID METHOD FOR DETERMINING WINTERHARDINESS IN ALFALFA. Agronomy Jour. 49: 88-92. 1957.

A laboratory technique is described for evaluating the winter-hardiness of alfalfa. Seeds were germinated in solutions of sodium chloride and sucrose having known osmotic pressures. As osmotic pressures were increased, the rapidity and amount of germination decreased; however, the decrease was more marked in the seed of hardy varieties.

Smith, D. FLOWERING RESPONSE AND WINTER SURVIVAL IN SEEDLING STANDS OF MEDIUM RED CLOVER. Agron. Jour. 49: 126-129. 1957.

Date of seeding influenced markedly the number of medium red clover plants that flowered during the seedling year. Plants that flowered were winterkilled more than nonflowering plants, and certain plant types winterkilled more than others. The variability in plant types occurring in spaced populations following certain seeding dates may aid in selection programs.

Smith, G. S. INHERITANCE OF HEAD CHARACTERS IN TETRAPLOID WHEAT HYBRIDS: I. GLUME TENACITY AND HEAD TYPE IN MINDUM DURUM X VERNAL EMMER. Agron. Jour. 49: 138-141. 1957.

In the cross Mindum durum X Vernal emmer, the tough-threshing character of the emmer parent was inherited in a complex manner. F_3 progenies relatively homozygous for intermediate degrees of threshability were recovered.

A two-factor hypothesis appeared to explain the appearance of clavate heads in this cross between two non-clavate parents, but was not established conclusively. Cl appeared to cause clavate in the absence of I, an inhibitor.

The I gene, or a closely linked gene was one of the major factors for tough threshing.

Smith, G. S. INHERITANCE OF STEM RUST REACTION IN TETRAPLOID WHEAT HYBRIDS: I. ALLELIC GENES IN MINDUM DURUM X VERNAL EMMER. Agron. Jour. 49: 134-137. 1957.

In the cross, Mindum durum X Vernal emmer, two allelic genes, Sr^m and Sr^v, were found to determine seedling resistance to stem rust races, 147 and 17, respectively. Sr^v also conditioned field resistance to stem rust.

Sowell, W. F., Rouse, R. D., and Wear, J. I. COPPER TOXICITY OF THE COTTON PLANT IN SOLUTION CULTURES. Agron. Jour. 49: 206-207. 1957.

Cotton plants growing in solution culture containing a copper concentration of 0.8 ppm. or higher developed toxicity symptoms consisting of a darkened root system and loss of turgidity in the aerial parts. A copper concentration of 0.4 ppm. produced no toxic effects.

Copper accumulated in high amounts in the tip and mid portions of the roots; whereas, only small amounts were translocated to the leaves.

Stacy, S. V., Steanson, O., Jones, L. S., and Foreman, W. J. JOINT EFFECTS OF MAXIMUM TEMPERATURES AND RAINFALL ON CORN YIELDS, EXPERIMENT, GEORGIA. Agr. Jour. 49: 26-32. 1957.

Maximum daily temperatures and rainfall averaged by 5-day periods for 18 periods during each growing season of a 38-year span were related to corn yields, using a set of second-degree orthogenal polynomials as regression integrals. Results indicated that high temperatures near the end of the growing season are beneficial if rainfall is adequate. High temperatures when no rainfall occurs causes greatest damage in the first half of June. The value of an inch of rainfall declines for a time after the usual planting date and then increases sharply during the latter part of the growing season, especially when associated with the higher temperatures which are normal for that period.

Staniforth, D. W. EFFECTS OF ANNUAL GRASS WEEDS ON THE YIELD OF CORN. Agron. Jour. 49: 551-555. 1957.

Corn yield reductions resulting from mature foxtail infestations averaged 14, 10 and 5 bushels per acre respectively, with applications of 0, 70 and 140 pounds of elemental nitrogen per acre. Corn yields were increased 2 to 3 times more than foxtail by the fertilizer applications. Possible effects of uncontrolled factors are recognized.

Stevenson, F. J. EFFECT OF SOME LONG-TIME ROTATIONS ON THE AMINO ACID COMPOSITION OF THE SOIL. Soil Sci. Soc. Amer. Proc. 20: 204-208. 1956.

The technique of ion exchange chromatography has been further refined for the isolation and quantitative determination of the ninhydrin-positive components of soil hydrolysates. The method was used to determine the effect of some long-time rotations on the distribution of amino acids in soils. The soils used for this purpose were taken from the Morrow Plots at the University of Illinois.

It was found that these plots differed in both the proportion of the soil nitrogen present as a-amino acid nitrogen and in the relative distribution of amino acids. The most striking difference was in the basic amino acid content of these soils, where a high quantity of basic compounds was associated with the untreated rotations. An explanation is given to account for these observations.

Tanada, T. EFFECT OF SULFHYDRYL INHIBITORS ON RUBIDIUM ABSORPTION BY EXCISED MUNG BEAN ROOTS. Plant Phys. 31: 403-406. Sept. 1956.

The absorption of Rb by excised mung bean roots has been found to be markedly affected by strong-SH inhibitors. Cu and phenylmercuric nitrate at low concentrations have been found to increase markedly Rb uptake in the absence of Ca. Rb absorption in the presence of Ca, however, was greatly reduced by these inhibitors. Weaker -SH poisons showed little or none of these effects. The suggestion was made that Rb absorption is mediated by a ribonucleic acid and protein complex which is held together by H bonds formed by certain critical -SH groups on the protein moiety, and that the strong -SH agents bring about their effects by their action on these -SH groups.

Tesar, M. B. ESTABLISHMENT OF ALFALFA IN WIDE-ROW CORN. Agronomy Jour. 49: 63-68. 1957.

Drilling and packing alfalfa seed in a band over fertilizer in corn rows 60 or 80 inches wide resulted in alfalfa stands and yields not significantly different from those produced by seedings made in oats. Packing after drilling resulted in stands 28 to 109 percent better than stands established without packing in the three years of tests. Data indicate that seedings will be more difficult to establish in corn than in oats in dry summers or drier portions of the corn belt. An apparent disadvantage is that seedings fail to establish in the area immediately adjacent to the corn rows.

Wahhab, A. INCIDENCE OF RUST ON IRRIGATED WHEAT AS AFFECTED BY TIME OF SOWING AND RATE AND TIME OF NITROGEN FERTILIZATION. Agron. Jour. 49: 185-187. 1957.

Date of sowing, application of nitrogen and time of application acted independently in affecting the incidence of rust in wheat. Date of sowing had no effect on rust incidence. Time of nitrogen application affected incidence of rust only at the low levels of infection. Application of nitrogen increased the incidence of rust significantly.

Wedin, W. F., Burger, A. W., and Ahlgren, H. L. EFFECT OF SOIL TYPE, AND STAGE OF GROWTH ON YIELD, CHEMICAL COMPOSITION, AND VALUE OF LADINO CLOVER. Agronomy Jour. 48(4): 147-152. April 1956.

In a 4-year Wisconsin study, greatest yields resulted on Miami silt loam and from cutting at intermediate growth stage. Yield increases from fertilization were greatest on soil types of lower productivity field rating. Highest contents of P, K, and N resulted in forage harvested on soil types of medium to high ratings, and from pasture stage harvests. Contents of P and K were increased, Ca decreased, and N unchanged by fertilization. Forage nutritive value measured in guinea pig feeding trials compared closely with field ratings of the soil types.

Wiggans, S. C., and Frey, K. J. TILLERING STUDIES IN OATS. II. EFFECT OF PHOTOPERIOD AND DATE OF PLANTING. Agron. Jour. 49: 215-217. 1957.

Oat varieties grown under various light and temperature conditions produced different numbers of head bearing tillers. All of the varieties tested needed more than 12 hours of continuous photoperiod to produce heads within 90 days. Plants grown at 58° F. did not head as rapidly as those grown at 70° F. The number of head bearing tillers per plant decreased with increased planting rates. Delaying planting from early April until the first week in May increased the number of heads per plant while plantings made after the first week in May decreased rapidly in number of heads per plant.

Williams, W. A., Doneen, L. D., and Ririe, David. PRODUCTION OF SUGAR BEETS FOLLOWING WINTER GREEN MANURE CROPPING IN CALIFORNIA. II. SOIL PHYSICAL CONDITIONS AND ASSOCIATED CROP RESPONSE. Soil Sci. Soc. Amer. Proc. 21: 92-94. 1957.

A procedure is described for measuring volumetrically the rate of water infiltration in field furrows. The technique developed was used to determine the effect of green manure crops on soil structure during the growth of a succeeding crop of sugar beets. At one location a green manure crop of barley increased the rate of infiltration. This result was associated with an increase in sugar production where nitrogen fertilization insured optimum fertility. Tractor travel in furrows was observed to have a significant depressing effect on the rate of infiltration.

Williams, W. A., and Ririe, D. PRODUCTION OF SUGAR BEETS FOLLOWING WINTER GREEN MANURE CROPPING IN CALIFORNIA: I. NITROGEN NUTRITION, YIELD, DISEASE, AND PEST STATUS OF SUGAR BEETS. Soil Sci. Soc. Amer. Proc. 21: 88-92. 1957.

Leguminous and nonleguminous winter green manure crops were grown in two field experiments and followed by sugar beets as a test crop. The latter were fertilized with several levels of nitrogen. The legume, purple vetch, made approximately 80 pounds of nitrogen per acre available to the succeeding crop as indicated by the response in sugar production and beet petiole analysis for nitrate-nitrogen. The nonlegume, barley, depressed sugar production from unfertilized sugar beets by making some soil nitrogen unavailable. The trend of the petiole nitrate-nitrogen content as influenced by the green manures and fertilization was observed through the season and was found to be closely related to the sucrose content of the beets at harvest.

Pasture and Range

Anderson, K. L., and Fly, C. L. VEGETATION-SOIL RELATIONSHIPS IN FLINT HILLS BLUESTEM PASTURES. Jour. Range Mgt. 8(4): 163-169. 1955.

Intensive plant population sampling by the line-transect method, together with detailed soils mapping in Flint Hills bluestem pastures of the Kansas Agricultural Experiment Station, has made it possible to relate vegetational composition to soils conditions. Statistical comparisons of the vegetational populations on 10 upland soils mapping units revealed that not all were different so far as vegetation was concerned. Five distinct upland range sites were delineated on the basis of both soil conditions and vegetation. Two of these support a vegetation that is climax for the region and three a vegetation that is preclimax in nature. The five are typical of a large section of the Flint Hills grazing region of Kansas.

Anderson, S. R., and Metcalfe, D. S. SEED YIELDS OF BIRDSFOOT TREFOIL (Lotus corniculatus L.) AS AFFECTED BY PRE-HARVEST CLIPPING AND BY GROWING IN ASSOCIATION WITH THREE ADAPTED GRASSES. Agron. Jour. 49: 52-55. 1957.

Spring and early summer clipping of birdsfoot trefoil reduced seed yields in comparison to unclipped stands. The association of Kentucky bluegrass, orchardgrass, or timothy reduced lodging and increased seed yields of birdsfoot trefoil. Kentucky bluegrass was superior to the other grasses. Two years after seeding, birdsfoot trefoil stands were thicker when grown with a grass than when grown alone. Tall-growing orchardgrass and timothy tended to delay maturity of birdsfoot trefoil. After the first harvest year, forage yields were slightly higher when the birdsfoot trefoil was grown with a grass.

Blakeslee, L. H., Harrison, C. M., and Davis, J. F. EWE AND LAMB GAINS ON BROME AND REED CANARYGRASS PASTURE. Mich. Agr. Expt. Sta. Quar. Bull., Mich. State Univ. of Agr. and Applied Sci., Vol. 39, No. 2, pp. 230-235. Nov. 1956.

Duplicate .9-acre pasture plots of well drained organic soil were seeded to reed canarygrass and northern smooth bromegrass in August 1952; they pastured with ewes and their lambs during the following three pasture seasons.

Lambs, with their dams, gained an average over the 3 years of .348 pounds per day on duplicate reed canarygrass pastures; comparable lambs on bromegrass areas gained .447 pound per day.

Because of greater carrying capacity, the reed canarygrass produced 333 pounds of lamb per acre the first year and averaged 249.6 pounds over the 3-year period. The bromegrass produced 300 pounds per acre the first pasture season and averaged 226 pounds for the three seasons.

The dams of the lambs made better gains on bromegrass each pasture season, averaging 75 pounds per acre over the 3-year period in comparison with 17 pounds per acre for reed canarygrass.

Reed canarygrass, though producing lower daily gains on lambs and ewes than smooth bromegrass, still gave satisfactory daily gains; because of a higher carrying capacity, it made satisfactory pasture.

On well drained organic soils, differences in lamb and ewe gains on reed canarygrass and bromegrass pastures were so small that individual farm management problems might be the most important reason for choosing one rather than the other.

Blaser, R. E., Griffeth, W. L., and Taylor, T. H. SEEDLING COMPOSITION IN COMPOUNDING FORAGE SEED MIXTURES. Agron. Jour. 48(3): 118-123. Mar. 1956.

Virginia studies show that seed ratio in mixtures of species should differ with spring and summer seedings. Summer alfalfa seedlings developed faster than spring, but stands were similar. Spring seeding of seed clover had faster growth and better stands than summer. Orchardgrass weights and stands were similar for both dates, but yields were higher from spring than from summer seedings. Red clover suppressed spring alfalfa and orchardgrass seedings.

Bohmont, B. L., and Lang, R. SOME VARIATIONS IN MORPHOLOGICAL CHARACTERISTICS AND PALATABILITY AMONG GEOGRAPHIC STRAINS OF INDIAN RICEGRASS. Jour. Range Mgt. 10: 127-131. 1957.

A study of variations in morphological characteristics and palatability of 12 geographic strains of Indian ricegrass was made.

The principal objectives were: (1) to determine morphological differences exhibited by geographic strains of Indian ricegrass; (2) to determine possible differences in palatability between the geographic strains and the constancy of such differences in strains grown on two soil types; and (3) to test the relationship between the chromogen content of plant material and palatability as a possible laboratory method for determining animal preference.

Indian ricegrass was found to have wide variation in growth habit, leaf type, and size and shape of seed. These differences are probably due to natural selection, and when the geographic strains were grown in a common nursery, the differences noted appeared to be inherent within the geographic strain.

In general, the seed of strains could be classified into two categories on the basis of shape: elongated and globose. A few of the collections showed intermediate characters.

Palatability ratings for the 12 strains of Indian ricegrass studied were determined by the percentages of forage of the different strains consumed by rabbits.

Branson, F. A. QUANTITATIVE EFFECTS OF CLIPPING TREATMENTS ON FIVE RANGE GRASSES. Jour. Range Mgt., Vol. 9, No. 2, pp. 86-87. Mar. 1956.

Root and shoot production are studied in five western range grasses subjected to three clipping intensities. Growth of both roots and shoots was inversely proportional to the intensity of clipping. However, root production was more detrimentally affected than top production. In all species the numbers of culms were greatest under the least severe of the clipping treatments.

Branson, F. A. RANGE FORAGE PRODUCTION CHANGES ON A WATER SPREADER IN SOUTHEASTERN MONTANA. Jour. Range Mgt. 9(4): 187-191. July 1956.

Yields, vegetational changes, and chemical composition of plants and soils were studied on a water spreader in southeastern Montana. Yields were 2.6 times greater on the water spreader than on the controls. Basal area increased considerably on the water spreader, on dikes, and in narrow pits. The most striking vegetational changes on the spreader were a decrease in aerial and basal cover of big sagebrush and pricklypear cactus and an increase in foxtail barley. In general, the protein, phosphorus, and calcium contents of plants from the water spreader were higher in plants from the controls.

Burcham, L. T., and Storie, R. E. SOIL-VEGETATION SURVEY INFORMATION IN RANGE MANAGEMENT PLANNING AND ADMINISTRATION. Soil Sci. Soc. Amer. Proc. 21: 108-111. 1957.

Since 1947 the State of California has been conducting a soil-vegetation survey--an inventory of the vegetative cover and underlying soils of the wild land areas of the state. This soil-vegetation survey is a particularly remunerative source of much information on the physical factors that affect the business of ranching. Practical applications of this information are discussed herein; a review of specific cases illustrates the value of these surveys in range management planning and administration. These cases also demonstrate that soil-vegetation surveys are a practical tool for both the rancher, and the range technician in public service or private enterprise. They are an extremely effective means of conveying information, and have a great potential for developing interest in, and an incentive for, better range management.

Burdick, M. D. NEED OF A UNIFIED SYSTEM FOR MEASURING RANGE PRODUCTIVITY. Jour. Range Management 10: 6, 8. 1957.

A unified system of measuring range productivity must contain provisions for appraisal of four factors, i.e., range site and condition class, degree of utilization of the herbage in relation to range conditions and trend, a standard unit of forage measurement clearly defined and readily translated, and supplemental data required to approximate equivalents in related sciences.

Burton, G. W., Southwell, B. L., and Johnson, J. C., Jr. THE PALATABILITY OF COASTAL BERMUDA GRASS (Cynodon dactylon (L) Pers.) AS INFLUENCED BY NITROGEN LEVEL AND AGE. Agron. Jour. Vol. 48, No. 8, pp. 360-362. Aug. 1956.

The palatability of coastal Bermuda grass was improved substantially by nitrogen fertilization. There was no evidence to indicate that annual rates up to 1,500 pounds of nitrogen per acre decreased the palatability of this grass. Two-week-old grass was more palatable than 4-week-old grass.

Canfield, R. H. REPRODUCTION AND LIFE SPAN OF SOME PERENNIAL GRASSES OF SOUTHERN ARIZONA. Jour. Range Mgt. 10: 199-203. 1957.

A record of 17 years of annual chartograph records on metersquare quadrats located on the Santa Rita Experimental Range provided a basis for studying life history characteristics of 11 common perennial grasses of the desert grasslands of southern Arizona.

Seedling production, seedling survival, and longevity of grasses in two groupings were compared: (1) primary grasses (black, side-oats, and hairy gramas, Arizona cottongrass, tanglehead, mesa threeawn, and Texas timothy) that tend to predominate on lands that receive light or no grazing or are maintained in good condition, and (2) secondary grasses (Rothrock, sprucetop, and slender gramas, and curlymesquite) that tend to occur sparingly on ungrazed ranges but are abundant on ranges in poor condition.

1. All grasses studied produced some seedlings or sets each year, but the number produced varied greatly by species. Secondary grasses usually produced more seedlings than the primary grasses. Rothrock grama and curlymesquite were the most prolific, followed by sprucetop and slender gramas. Arizona cottongrass produced the least seedlings.
2. All secondary grasses and Texas timothy produced more seedlings where grazed than where protected. Black, hairy, and side-oats gramas, and tanglehead produced more seedlings or sets where ungrazed than where grazed. Grazing seemed to have little effect on seedling production of Arizona cottongrass and mesa threeawn.
3. Mortality of seedlings and young plants was especially high during the first 2 years.
4. Black and sprucetop gramas, Arizona cottongrass, and mesa threeawn were the longest lived with some plants of black grama living 14 years. Rothrock grama was the shortest lived; no plant lived more than 3 years where protected or more than 4 years where grazed.
5. In general, the primary grasses tended to be longer lived where protected than where grazed; whereas the opposite was true of the secondary grasses.

Cooper, A. S. THE EFFECT OF TIME AND HEIGHT OF CUTTING ON THE YIELD, CRUDE PROTEIN CONTENT AND VEGETATIVE COMPOSITION OF A NATIVE FLOOD MEADOW IN EASTERN OREGON. Agron. Jour. 48: 257-258. June 1956.

Four years of differential cutting treatments had no effect upon fifth year yield. Yield declines were associated with loss of soil fertility. No significant changes occurred in vegetative composition. Crude protein content decreased with maturity and increased with cutting height.

Davis, R. R., and Bell, D. S. A COMPARISON OF BIRDSFOOT TREFOIL-BLUEGRASS AND LADINO CLOVER-BLUEGRASS FOR PASTURE: I. RESPONSE OF LAMBS. Agron. Jour. 49: 436-440. 1957.

During the first grazing year, a Ladino clover-bluegrass mixture was more productive in terms of carrying capacity, gain per acre, and TDN consumption per acre than an Italian birdsfoot trefoil-bluegrass mixture. The trefoil mixture was more productive the remaining two years of the test. Ladino clover was eliminated from the mixture by drouth. Continuous grazing killed the birdsfoot trefoil. The trefoil remained in the mixture when grazed with a rotation system of about two weeks grazing and four weeks rest.

Fletcher, J. E., and Robinson, M. E. A CAPACITANCE METER FOR ESTIMATING FORAGE WEIGHT. Jour. Range Mgt. 9(2): 96-97. Mar. 1956.

A capacitance method for determining forage is proposed. The true precision of the method is not known at present. Indications are, however, that areas are more truly characterized by the capacitance method than by clipping due to the more complete sampling made possible by the rapidity of the method. The method is unique for small plots in that the forage remains relatively undisturbed even after repeated determinations.

Gibson, P. B. EFFECT OF FLOWERING ON THE PERSISTENCE OF WHITE CLOVER. Agron. Jour. 49: 213-215. 1957.

Persistence and flowering of white clover were studied under normal daylight and daylight extended by use of lights. The relative lack of persistence of profuse-flowering white clover which occurred in some strains under normal daylight and was induced in other strains by the extended daylight indicated that flowering reduced persistence. The flowering and persistence of Ladino from seed produced at different latitudes for several generations were different under the extended daylight.

Grabe, D. F. ARTIFICIAL DRYING AND STORAGE OF SMOOTH BROMEGRASS SEED. Agron. Jour. 49: 161-165. 1957.

Freshly harvested bromegrass seed containing up to 28% moisture was successfully dried with a field drier in less than 6 hours without lowering viability of the seed. Bromegrass resisted heat injury from temperatures that have been reported harmful to several other grass species. Laboratory studies showed that resistance to heat injury increased with lowered moisture content of the seed. For safe storage, the moisture content of bromegrass seed should be reduced to 12 percent or less soon after harvest.

Grube, D. F. MATURITY OF SMOOTH BROMEGRASS. Agron. Jour. 48: 253-256. June 1956.

Some seeds were capable of germination 5 days after flowering. Maximum germination, dry weight, and seedling vigor were attained in 17 or 18 days. Moisture content decreased slowly from over 60 percent to 47 percent at the time functional maturity was reached. After this time, loss of moisture was accelerated and the seed entered the ripening phase.

Hauser, E. W., and Thompson, J. T. JOHNSON GRASS CONTROL IN GEORGIA. Geo. Agr. Expt. Sta. Leaflet No. 13. March 1957.

For the past three years investigations for the control of Johnson grass have been conducted cooperatively by the Georgia Experiment Station and the United States Department of Agriculture. These tests were located near Experiment and Plains, Georgia. This leaflet is a progress report on results obtained during 1954, 1955, and 1956 together with suggested preliminary recommendations for Johnson grass control.

Hauson, H. C. THE USE OF BASIC PRINCIPLES IN THE CLASSIFICATION OF RANGE VEGETATION. Jour. Range Management 10: 26-33. 1957.

The description and classification of range types should be based upon principles pertaining to properties that are inherent in the vegetation. Principles to consider may be arranged in three classes: (1) principles dealing with the relations of the species to the environment; (2) principles dealing with relations between species; and (3) the ecological success of a species in a community. Application of the principles and the classification to range management are indicated.

Holt, E. C., and Smith, O. E. CROPS AND CULTURAL PRACTICES FOR SILAGE PRODUCTION, COLLEGE STATION AND PRAIRIE VIEW, 1952-55. Prog. Report 1858. Tex. Agr. Expt. Sta. Mar. 26, 1956.

Silage yields of sorghum varieties were not influenced by planting rates in experiments conducted at College Station and Prairie View, 1952-55. Rates in these studies ranged from 7 to 28 pounds per acre in rows and from 40 to 100 pounds broadcast. Broadcast stands and heavier seeding rates resulted in smaller stalks. Forage from broadcast plantings had a higher percentage of stalks than that from row plantings.

When used as a soiling crop, sorghum produced higher yields when allowed to grow to the boot stage than when cut earlier. Prussic acid content of the forage should also be lower at the later stage of growth.

Hood, A. E. M. NITROGENOUS MOWING OF GRASS-CLOVER LEYS FOR CONSERVATION, WITH PARTICULAR REFERENCE TO 'LATE' TOP-DRESSING. Jour. Agr. Sci. 48(2): 145-148. 1956.

Results are recorded of experiments over four years to study the effects of various rates of N fertilizer applied early and late to grass-clover swards cut repeatedly for conservation. Nitrogen fertilizer proved essential for high yields of dry matter and protein per acre. It reduced the amount of clover, but it is clear that clovers are not as productive as grasses adequately fertilized, and that any nitrogen provided by clovers is far from enough to enable associated grasses to make full growth.

Hormay, A. L. HOW LIVESTOCK GRAZING HABITS AND GROWTH REQUIREMENTS OF RANGE PLANTS DETERMINE SOUND GRAZING MANAGEMENT. Jour. Range Management, Vol. 9, No. 4, pp. 161-164. July 1956.

The basic requirement for range improvement is proper management of grazing. Selective grazing of the vegetation is the prime cause of range deterioration. Selective grazing cannot be prevented, but its harmful effects can be overcome by resting the range from grazing at intervals. Resting must be tried so as to provide the key forage species on the range the opportunity to reproduce on a continuous basis. Periodic resting from grazing is essential for the improvement and maintenance of burchgrass type ranges and for maximum sustained livestock production.

Houston, W. R. RENOVATION AND FERTILIZATION OF CRESTED WHEATGRASS STANDS IN THE NORTHERN GREAT PLAINS. Jour. Range Management 10: 9-11.

The effects of renovating or fertilizing old crested wheatgrass stands were studied, near Miles City, Montana, in 1944 and in 1950-52. Treatments consisted of springtooth harrowing, double disking, plowing and reseeding, and nitrogen fertilization. Nitrogen fertilization at the rate of 50 pounds of N per acre increased forage production to some extent in the year of application, but two years after application this response had largely disappeared. Considerable disturbance of the stand by double disking or plowing and reseeding caused decreased forage and seed production and increased weed growth in the first year.

Houston, W. R. SEEDING CRESTED WHEATGRASS ON DROUGHT DEPLETED RANGE. Jour. Range Mgt. 10: 131-134. 1957.

Crested wheatgrass was seeded on native range in a replicated, split plot design in 1938 and 1939. Spring and fall seedings were compared with each other and with non-seeded native range. Changes in vegetation density and production were followed from 1938 to 1950, a period of recovery from the drought of the 1930's.

From this study the following conclusions were drawn:

1. Fall seeding of crested wheatgrass was superior to spring seeding in obtaining successful stands, where competing vegetation was not removed.
2. Crested wheatgrass in the first few years after seeding was hindered by competition from native range vegetation with a basal area density of 4 percent or more.
3. Native perennial grass species, particularly blue grama, tended to increase in density and production more rapidly at the end of a drought period than did crested wheatgrass planted at the end of a drought.
4. The observed increase in crested wheatgrass and perennial grass production was at the expense of annual grasses.
5. After twelve years of recovery from drought under protection from grazing, range, which had been seeded to crested wheatgrass at the end of the drought, produced 700 percent more perennial grass forage and two to two and one-half times as much total production as did native range under the same conditions.

Hubbard, R. L. THE EFFECTS OF PLANT COMPETITION ON THE GROWTH AND SURVIVAL OF BITTERBRUSH SEEDLINGS. Jour. Range Mgt. 10: 135-137. 1957.

Seedbed preparation, alone and with subsequent weeding, permitted greatly increased seedling growth of bitterbrush and reduced seedling mortality. Even though some of the seedlings growing under heavy competition from native plants may survive many years, there is little chance that they will break free of the competition and become dominant plants. This study was conducted under favorable site and precipitation conditions. Preliminary results from another study indicate that complete mortality of emerged bitterbrush seedlings may occur under less favorable conditions on native, untreated areas.

Weeding after seedbed preparation increased the growth rate of bitterbrush seedlings over soil preparation without follow-up weeding, but the increase was not enough to warrant the extra expense. Weeding could not be justified in an extensive range seeding program.

Planted crested wheatgrass provided about the same level of competition as native vegetation, judging from growth performance of bitterbrush seedlings. It may sometimes be desirable to seed both bitterbrush and crested wheatgrass to provide additional forage, reduce livestock use of bitterbrush, or aid fire protection. Seeding of this type was done (U. S. Forest Service, 1950) in Oregon with the two species sown in alternate drill rows. Seeding alternating drill widths might be another feasible method. Mixing the two species, as in the present study, seems unlikely to give satisfactory results.

Johnston, A. A COMPARISON OF THE LINE INTERCEPTION, VERTICAL POINT QUADRAT, AND LOOP METHODS AS USED IN MEASURING BASAL AREA OF GRASSLAND VEGETATION. Canad. Jour. Agr. Sci. 37: 34-42. 1957.

A study was designed to determine the most efficient sample size and number of samples when any one of the line-interception, vertical point quadrat, or loop methods of vegetation survey is used, on different range types in southern Alberta. The procedure has involved obtaining basal area measurements by all methods on ten transects, 100 feet long, within each range type.

Sampling intensities sufficient to sample the dominant and minor species to within ± 10 percent of their true mean basal area, and the precision obtained when minor species were sampled at intensities found adequate for the dominant species, were calculated. Measurement of minor species at the latter intensities was highly variable. The loop method was the most rapid in the field, detected least species, and gave the most variable data. Data collected by this method was especially variable when the dominant plant species were of the single stemmed type. The line interception method was the most time-consuming, detected more species than either the loop or point methods and gave data which were slightly more variable than the point method. The point method gave the least variable data and, in general, seemed the most satisfactory of the three methods in the vegetative types studied.

Klemmendson, J. O. INTERRELATIONS OF VEGETATION, SOILS, AND RANGE CONDITIONS INDUCED BY GRAZING. Jour. Range Mgt. 9(3): 134-138. May 1956.

Studies were made in the high mountain park type of western Colorado to determine the changes in vegetational cover, soil stability, and physical condition of the soil that occur with declining range condition. After delineation into sites and range condition classes, the areas were sampled for plant density, composition, and indicators of soil stability by a modification of Parker's 3-step method and by observation. Infiltration rates were measured with a tin-can infiltrometer. Data on the physical condition of the surface soil were obtained by laboratory analysis.

Plant density decreased with a downward trend in range condition. Desirable species diminished and intermediate and undesirable species showed an increase with deterioration in range condition. A greater change was noted from fair to poor than from good to fair condition. Physical soil conditions also deteriorated with a downward trend in range condition. Prominent indications of soil disturbance and instability such as erosion pavements, plant pedestalling, bare soil, and degree of litter cover became more evident as range deteriorated. Less noticeable indicators such as alluvial deposits, orientation of litter, rock pedestals, and soil washing and crusting furnished supporting evidence of trends and revealed current happenings.

As shown by infiltration studies and measurements of organic matter content, volume weight, and pore-size distribution, the physical condition of the soil deteriorates with a trend from good to poor range condition.

Kneebone, W. R. BLUE GRAMA SEED PRODUCTION STUDIES. Jour. Range Management 10: 17-21. 1957.

Seed production studies were made in 1953-55, inclusive, on an established stand of blue grama drilled in 12-inch rows at Woodward, Oklahoma. Excellent heading and seed set were obtained in 1954 and 1955 by applying water on ammonium nitrate fertilizer to summer dormant grass in mid-August, with continued irrigation until seed was in the soft dough stage. In 1954, plots to which 50 pounds of nitrogen per acre were applied, produced 326 pounds of rough seed per acre while checks yielded 81 pounds. A considerable amount of forage was produced each year in addition to the seed. Total air dry yields of seed and forage on fertilized plots averaged 3,648 pounds per acre in 1954 and 4,127 pounds in 1955.

Kroontje, W., and Kehr, W. R. LEGUME TOP AND ROOT YIELDS IN THE YEAR OF SEEDING AND SUBSEQUENT BARLEY YIELD. Agron. Jour. 48(3): 127-131. Mar. 1956.

Various management practices were found to have the following effects: no significant difference in forage and root yields among 6 alfalfa varieties and between hardy and nonhardy varieties; forage production of Hubam and Madrid sweetclovers were equal; and Madison and Hairy Vetch similar in forage, root, and total N production. Barley yields following alfalfas and Hubam sweetclover were similar; Madrid depressed barley yields; and the vetches were superior to all legumes in effect on barley yield.

Laude, H. M. GERMINATION OF FRESHLY HARVESTED SEED OF SOME WESTERN RANGE SPECIES. Jour. Range Mgt., Vol. 9, No. 3, pp. 126-129. May 1956.

Dormancy of freshly harvested seed was encountered in smilo grass, broad-leaf filaree and twelve annual grasses. The duration of delayed germination varied with the species. For a given species it varied both from year to year and among locations of seed production. In the annual grasses dormancy of fresh seed persisted from one to five months, decreasing with time after seed maturity. It appears unlikely that seed of these species would germinate in the field during the spring of seed production, but by mid-summer or autumn most could germinate readily.

Lehrer, W. P., Jr., and Tisdale, E. W. EFFECT OF SHEEP AND RABBIT DIGESTION ON THE VIABILITY OF SOME RANGE PLANT SEEDS. Jour. Range Mgt., Vol. 9, No. 3, pp. 118-122. May 1956.

The effects of sheep and rabbit digestion on the viability of seeds of seven western range plants are reported. Viable seeds remained in the digestive tracts of sheep for as long as 9 days and in that of rabbits for 4 days. The proportion of viable seeds recovered was relatively small for all species studied. It is entirely feasible for sheep and rabbits to transport viable seed via their digestive systems for great distances and, consequently, to contribute materially to the spread of various plants in relatively short periods of time.

Metcalfe, D. S., Johnson, I. J., and Shaw, R. H. THE RELATION BETWEEN POD DEHISCENCE, RELATIVE HUMIDITY AND MOISTURE EQUILIBRIUM IN BIRDSFOOT TREFOIL, Lotus corniculatus. Agron. Jour. 49: 130-134. 1957.

Birdsfoot trefoil pods of clone B74 dehisced at a relative humidity of 29.5% but not at 35%. Pods from a bulk sample of the Empire strain dehisced at a relative humidity of 40% suggesting that differences occur among lots of mature pod. There was a close interdependence of relative humidity, moisture equilibrium and pod splitting. At low relative humidity, moisture content of pods was reduced rapidly to the point of dehiscence. Temperature, a factor in relative humidity, varied as much as 10° F. from air temperature. Increase of pod temperature in full sunlight may be enough to reduce relative humidity and pod moisture and bring about pod dehiscence.

Nelson, C. E., and Robins, J. S. SOME EFFECTS OF MOISTURE, NITROGEN, FERTILIZER, AND CLIPPING ON YIELD AND BOTANICAL COMPOSITION OF LADINO CLOVER-ORCHARDGRASS PASTURE UNDER IRRIGATION. Agron. Jour. 48(3): 99-102. Mar. 1956.

On Ephrata fine sandy loam in Washington greater acre yields were obtained from mid-summer irrigation at 7- to 11-day frequency and 12-inch clipping height than at longer frequency and less height. Clover percentage was highest under most frequent treatments. Clipping height did not affect botanical composition. Third-year results showed greatest total yield from 100 pounds N per acre applied in equal increments in April, June, and August.

Prime, G. M., and Burton, G. W. THE EFFECT OF NITROGEN RATE AND CLIPPING FREQUENCY UPON THE YIELD, PROTEIN CONTENT, AND CERTAIN MORPHOLOGICAL CHARACTERISTICS OF COASTAL BERMUDA GRASS. (Cynodon dactylon, (L) Pers.) Agron. Jour. 48(7): 296-301. July 1956.

Increasing the nitrogen rate from 0 to 900 pounds per acre annually increased hay yield protein percentage, protein yield, stem length, leaf length, internode length, and internode number in coastal Bermuda grass, but decreased leaf percentage seed-head frequency, and percentage nitrogen recovery. Increasing the clipping interval from 1 to 8 weeks increased hay yield, stem length, leaf length, plant height, seed-head frequency, internode length, and internode number, had little effect on protein yield and percentage nitrogen recovery, and decreased the protein percentage and leaf percentage.

Rauzi, F., and Lang, R. L. IMPROVING SHORTGRASS RANGE BY PITTING. Wyo. Agr. Expt. Sta. Bull. 344, Aug. 1956.

Pitting was still effective in increasing grazing capacity and lamb gain per acre 13 years after it had been initiated, yet the effectiveness of the treatment has declined because of filling and revegetation of the pits.

Rechenthin, C. A. ELEMENTARY MORPHOLOGY OF GRASS GROWTH AND HOW IT AFFECTS UTILIZATION. Jour. Range Mgt. 9(4): 167-170. July 1956.

Early in its life, the grass seedling has growth habits that enable it to survive in spite of grazing animals. The seedling becomes firmly attached to the soil cover after germination and is able to stand trampling and to resist being pulled from the soil by grazing animals. A study of the structure of the grass plant shows how the location of the meristematic tissue affects its utilization.

Reuss, L. A., Roberts, N. K., and Greene, R. E. L. PANGOLAGRASS PASTURES FOR BEEF PRODUCTION IN CENTRAL FLORIDA--A METHOD OF DETERMINING THE ECONOMICS OF ESTABLISHING AND FERTILIZING THEM. Univ. of Fla. Agr. Expt. Sta. Bull. 585. May 1957.

The ohief objectives of this study were: (1) To illustrate, by use of ranch budgets the types of information and analyses that will help ranchers answer some of these questions as they apply to their own ranches; and (2) for the situations represented by the budgets, to illustrate the economic relationships involved and the effects of selected combinations of conditions on net returns. In addition, brief attention is given to some aspects of the proposal that ranchers concentrate fertilizer on a part of the improved pasture acreage; and, the effects of alternative fertilization and improvement plans on capital required in the ranch business.

Ridgman, W. J., Hanley, F., and Barker, M. G. STUDIES ON LUCERNE AND LUCERNE-GRASS LEYS III. THE EFFECT OF VARIETY OF LUCERNE AND STRAIN OF GRASS. Jour. Agr. Sci. 47(1): 50-58. Feb. 1956.

An experiment comparing the growth and productivity of six varieties of lucerne representing a wide diversity of ecological conditions grown in association with S37 Cocksfoot and a commercial cocksfoot/timothy mixture is described and the results discussed. Variety of lucerne had a marked effect on establishment, persistence, recovery from defoliation, early spring growth, yield of total dried produce, proportion of lucerne in that produce and on yield of nitrogen. There was no evidence of differing degrees of compatibility of varieties of lucerne with the three strains of grass used.

Rogers, T. H., and Gardner, F. P. SEASONAL AND YEARLY PRODUCTION OF ANNUAL WINTER GRASSES AND GRASS-LEGUME COMBINATIONS FOR TEMPORARY WINTER GRAZING IN GEORGIA. Agron. Jour. 48: 546-551. 1956.

Winter annual grasses differed in seasonal and yearly production. Certain grasses initiated peak growth during all or early winter while others made peak growth during the spring. None of the grasses was highly productive throughout the winter, but distribution of forage and total yields were improved by combinations of grasses with dissimilar growth periods. Peak growth and clipping injury were associated with floral initiation and stem elongation. Crimson clover made little contribution to the yield of mixtures until spring. Supplemental nitrogen increased the forage yield over grass-legume combinations during the fall and winter periods.

Scholl, J. M., and Staniforth, D. W. ESTABLISHMENT OF BIRDSFOOT TREFOIL AS INFLUENCED BY COMPETITION FROM WEEDS AND COMPANION CROPS. Agron. Jour. 49: 432-435. 1957.

Seeding without a companion crop, reducing competition from companion crop by grazing and the use of selective herbicides are means of increasing chances of successful establishment of birdsfoot trefoil. Pre-emergence applications of TCA or post-emergence dalapon have controlled grassy weeds and enhanced survival and vigor of trefoil seedlings. A combination of dalapon and 4(2,4-DB) has shown promise of controlling grasses and many broadleaf weeds without serious injury to the trefoil.

Sharp, L. A., Hironaka, M., and Tisdale, E. W. VIABILITY OF MEDUSA-HEAD (Elymus caputmedusae L.) SEED COLLECTED IN IDAHO. Jour. Range Mgmt. 10: 123-126. 1957.

This paper reports the results of seed viability and germination tests of medusahead, an undesirable winter annual grass now infesting approximately 190,000 acres of rangeland in Idaho. At present this species is largely confined to ranges formerly occupied by native perennials, and more recently by annuals, especially cheatgrass.

Medusa-head produces a large amount of seed annually, and fairly high viability is attained even when seed is collected while the heads still retain a greenish color. Carryover of viable seed in both litter and soil is shown to occur for one year at least. Fire-damaged seed from burned areas did not germinate in the laboratory, but substantial numbers of undamaged seeds from the burned areas germinated readily.

Short, L. R., and Woolfolk, E. J. PLANT VIGOR AS A CRITERION OF RANGE CONDITIONS. Jour. Range Mgt. 9: 66-69. 1956.

The vigor concept, using leaf heights of bluestem wheatgrass plants growing within and outside pricklypear clumps was studied for three years on northern Great Plains ranges in good and poor condition. The study was conducted on range areas used in a rate-of-stocking beginning in 1931.

Resulting data showed that plant vigor, as expressed by bluestem wheatgrass heights, varied with range conditions, with protection afforded by pricklypear, and with precipitation.

Analysis of variance substantiated the relationship between bluestem heights unprotected by pricklypear in two range condition situations. Extrapolations of the established relationship indicated the possible development of two alternative vigor classifications based on the percentage relationship of unprotected to protected bluestem wheatgrass heights.

Primarily, the study established the usefulness of vigor, as reflected by plant height, as a criterion for the appraisal or estimation of range conditions.

Slipher, J. A. SOIL PREPARATION FOR MEADOW CROPS. Agr. Engin., Vol. 37, No. 10, pp. 681-684. Oct. 1956.

Soil properties and preparation methods are analyzed objectively in an effort to establish the "hallmark" of a correctly fitted soil for meadow crops.

Thakar, C., Shands, H. L., and Evans, R. I. SPRING SMALL GRAIN ANATOMICAL RESPONSE TO TOP GROWTH CLIPPING. Agron. Jour. 48(3): 123-126. Mar. 1956.

Stems of top growth clipped field plants of 1 wheat, 3 oats, and 3 barley varieties had vascular bundles more closely arranged and smaller in diameter than those of unclipped plants. High temperature (78° F.) reduced stem diameters, number of Xylem strands and number of metaxylem vessels. No single causal factor for lodging was isolated although several associations were observed.

Valassis, V., Hedrick, D. W., and Hill, D. D. THE PERFORMANCE OF SEVERAL IMPROVED FORAGE SPECIES ON LAUGHLIN-LIKE SOILS IN WESTERN OREGON. Jour. Range Mgmt. 10: 94-98. 1957.

Studies were undertaken in 1953 to evaluate seedings made in 1943 on marginal, oak-covered hill lands in the Willamette Valley near Corvallis. The soil was found to be Laughlin-like having developed in situ from marine shale and sandstone. Although it has good physical properties, it is low in pH and deficient in essential nutrients, notably phosphorus.

Out of the sixteen species originally planted in 1943 under four different methods of seedbed preparation, only six persisted as recognizable stands. Of these stands, only highland bentgrass could be considered as relatively good and uniform at the start of the study. However, stands of Alta fescue, both tall meadow and Tualatin oatgrasses, chewings fescue, and burnet made remarkable recovery following two seasons protection from grazing.

Chewings and Alta fescue in 1954 produced 50 percent of their seasonal production by May 1. Tall meadow oatgrass was also a heavy producer of early spring forage, whereas highland bentgrass, Tualatin oatgrass, and burnet all produced a greater proportion of feed in late spring and summer. The importance of this relative seasonal production to a pasture improvement and management program was pointed out.

Willhite, F. M., Rouse, H. K., and Siemer, E. G. IMPROVING COLORADO MOUNTAIN MEADOWS. Colo. Agr. Expt. Sta. Gen. Ser. Paper 644. July 1956.

Four major limiting factors were considered in this study. They were: (1) elevation or length of growing season; (2) plant nutrient deficiencies; (3) excessive irrigation; and (4) stage of maturity at harvest. The study has resulted in the development of certain principles of production which will enable ranchers to reduce the area of meadowland needed to produce forage for winter feeding. It also provides for better range conservation by producing meadow hay for feed during the time necessary for conserving and improving rangeland.

Wilson, D. B., and Peake, R. W. SEASONAL YIELD AND NITROGEN CONTENT OF THREE GRASSES GROWN SINGLY AND IN MIXTURES. Candd. Jour. Agr. Sci. 36: 221-232. 1956.

To test the assumption that each grass species will maintain its individual seasonal-growth trend when grown in a mixture of species, plots were established in 1952 on irrigated land. Smooth brome grass, orchard grass, and creeping red fescue were grown alone, and in all combinations with each other and with white Dutch clover. Seasonal growth treands and yields of each species, alone and in associations, were compared for five clipping harvests in 1953 and 1954. Total yields of mixtures were also compared, and the contribution of each species was considered. Percent protein of the separated species was determined in 1953.

Competition between species in the mixtures prevented the weaker competitors from exhibiting their individual characteristics. Orchard grass was the strongest competitor, brome grass was next, and creeping red fescue was the weakest. White Dutch clover was almost completely dominated by orchard grass, and affected to a lesser degree by the other two grasses.

Young, V. A. THE EFFECT OF THE 1949-1954 DROUGHT ON THE RANGES OF TEXAS. Jour. Range Management, Vol. 9, No. 3, pp. 139-142. May 1956.

The damage resulting on the ranges of Texas from the 5-year drought period, 1949-1954, can be correlated with land management and the type of soil. In general, ranges that were properly managed before and during the drought came through in fair to good condition; over-stocked ranges were severely damaged and subsequent recovery has been limited. Thus ranchmen have evidence of the need for carrying out proper management practices year after year, not only to meet drought periods, but to build for an economic unit by capitalizing on the years of favorable moisture. Thus the old rule still prevails that close grazing does not pay.

Weed, Brush, and Pest Control

Allison, D. V., and Rechenthin, C. A. ROOT PLOWING PROVED BEST METHOD OF BRUSH CONTROL IN SOUTH TEXAS. Jour. Range Mgt., Vol. 9, No. 3, pp. 130-133. May 1956.

Grass recovery, either of native or seeded grasses, was greatest where the soil surface was disturbed and a mulch left such as in root plowing or chopping. Raking following other treatments generally destroyed considerable grass, but did prepare a good seedbed for range seeding. It is doubtful if results justify the additional cost of raking.

Bergeson, E. D., and Lorenz, R. W. SEASONAL EFFECTIVENESS OF 2,4, 5-T BASAL SPRAYS FOR ERADICATING RIBES IN WHITE PINE BLISTER RUST CONTROL IN ILLINOIS. Jour. Forestry 55: 17-19. 1957.

In Illinois basal sprays of 2, 4, 5-T in No. 1 fuel oil are effective for the control and eradication of _Ribes_ _missouriense_ during any season of the year. This type of chemical control is easier and more efficient than hand-pulling or grubbing. It costs only about one-third as much. An additional advantage is the fact that labor is more readily available during the dominant season than during the growing season and then, too, it is not practical to hand-pull or grub ribes while the soil is frozen.

Friesen, H. A., and Walker, D. R. A COMPARISON OF MCP AND 2, 4-D FOR THE CONTROL OF ANNUAL WEEDS IN GRAIN CROPS. Canad. Jour. Agr. Sci. 37: 69-81. 1957.

Oats, flax and barley were sprayed with various formulations of MCP (2-methyl-4-chlorophenoxyacetic acid) and 2, 4-D (2, 4-dichlorophenoxyacetic acid) at a number of Experimental Farms in Western Canada in 1954 and 1955. Each formulation was applied at 4 and 8 ounces of acid equivalent per acre at each of two dates, viz., _Date 1_, when the weeds were in the seedling stage less than 3 inches in height; and Date 2, at a stage coinciding with the first appearance of buds on the major weed species.

Stinkweed (Thlaspi arvense, L.), wild mustard (Brassica kaber (DC.) L. C. Wheeler var. pinnatifida (Stokes) L. C. Wheeler), lamb's quarters (Chenopodium album L.), Russian pigweed (Axyris amarantoides L.), and ball mustard (Neslia paniculata L.), were effectively controlled by each of the MCP and 2, 4-D formulations used. Russian thistle (Salsola kali L.), and red-root pigweed (Amaranthus retroflexus L.), were not satisfactorily controlled by MCP, whereas hemp nettle (Galeopsis tetrahit L.) was not controlled by 2, 4-D. Wild buckwheat (Polygonum convolvulus L.) was not controlled by any of the treatments. Each treatment was more effective when applied during the seedling stage of the weeds.

On the basis of weed control and yield of grain the results of this study favour the use of MCP over 2, 4-D with either oats or flax. Oats was significantly more tolerant to MCP, particularly if treated during the early growth stages when weed competition was most critical. With flax, the difference in tolerance was most pronounced in favour of MCP at the later date of treatment. The 2, 4-D ester and low volatile ester resulted in a preponderance of plant deformities, lowered the yields of both oats and flax and delayed the maturity of flax significantly. Barley yields in this study were not adversely affected by any of the treatments.

Liljedahl, J. B., Carleton, W. M., and Kinch, D. M. WEED CONTROL IN THE ROW. Agr. Engr. 37(8): 550-552 and 554. Aug. 1956.

An investigation of a method for damaging weed seeds in a machine, which throws soil containing weed seeds against an impact plate by means of a rotating impeller, revealed some interesting results.

When mustard seed was allowed to soak for about 40 hours it was possible to reduce the germination to zero by mechanically processing the soil in which the seed was mixed. In greenhouse tests the number of weed seeds germinating was significantly reduced when the soil was treated at low impeller speeds and significantly increased when the soil was treated at high impeller speeds.

Myers, L. E., Jr. SOIL AND WATER MANAGEMENT IN RELATION TO MOSQUITO CONTROL. 24th Annual Conference of the Calif. Mosquito Control Assoc., 1956.

In 1955, U. S. Public Health Service and Agricultural Research Service cooperative field studies were initiated in the Milk River Valley, Montana, to determine if improved fertilization and irrigation practices could be developed which would increase bluejoint (Agropyron smithii) yields on heavy Bowdoin clay soils and at the same time decrease mosquito production. Results indicate that a five-fold increase in bluejoint yields is possible when heavy fertilized with nitrogen and 60 percent of the available moisture within the root zone is allowed to deplete prior to irrigation. Mosquito production under these conditions was elininated, whereas adjacent flooded borders representing former irrigation practice in the area produced an abundance of Aedes and Culex tarsalis mosquitoes.

Roach, M. E., and Glendening, G. E. RESPONSE OF VELVET MESQUITE IN SOUTHERN ARIZONA TO AIRPLANE SPRAYING WITH 2, 4, 5-T. Jour. Range Mgt. Vol. 9, No. 2, pp. 70-73, Mar. 1956.

Tests were made of the effects of ester and ammine of 2, 4, 5-T volume of spray application, ratio of oil-water in the corner, diesel oil and nontoxic acid, and site on spraying of velvet mesquite by airplane. The percentage plant kills ranged from 5 to 65 for different treatments at different sites, and averaged 23 percent for all tests. Percentage top kills ranged from 58 to 91 and averaged 75.8 percent for all treatments on all sites.

Wiese, A. F., and Rea, H. E. CHEMICAL CONTROL OF BROADLEAVED ANNUALS IN SORGHUMS. Tex. Agr. Expt. Sta. Prog. Rpt. 1861. 1956.

Under dryland farming conditions at the Amarillo Experiment Station, stands of broadleaved annual weeds in sorghum were reduced 83 percent when the soil was extremely dry, and 88 percent under more favorable growing conditions, with 1/2 pound of 2, 4-D ester per acre. These weeds were not controlled as effectively with 2, 4-D amine. Experiments under irrigated conditions with 2, 4-D amine indicate that sorghum is most tolerant to 2, 4-D when it is 6 inches tall or before it is 23 inches tall (early boot stage).

Wiese, A. F., and Rea, H. E. CHEMICAL CONTROL OF BLUEWEED. Tex. Agr. Expt. Sta. Prog. Rpt. 1862. 1956.

Spraying the foliage of thrifty blueweed in the late bud stage at the Amarillo Experiment Station in June 1954 with 1 pound of 2, 4-D ester in 40 gallons of water per acre reduced the stand 98 percent by September 1955. Similar results were obtained from the use of 1 pound of 2, 4-D ester and 6.4 pounds of Dreft in 40 gallons of water per acre.

Practical rates per square rod of soil sterilants for blueweed eradication were sodium chlorate at 5 pounds, Concentrated Borascu at 16 pounds, Atlacide at 5 pounds, Bolybor Chlorate at 10 pounds, Karmex FW at 3/8 pound and DB Granular at 6 pounds. Soil treated with these sterilants may be barren for several seasons.

Wiese, A. F., and rea, H. E. USE OF 2, 4-D ON WINTER WHEAT. Tex. Agr. Expt. Sta. Prog. Rpt. 1860. 1956.

Experiments to determine the tolerance of winter wheat to 2, 4-D were conducted at the Amarillo Experiment Station in the 1953-54 and 1954-55 crop seasons. The results indicate that if growing conditions are favorable, fall applications of 2, 4-D may reduce tillering, delay maturity and lower yields. Fall applications of 2, 4-D should be made only when weed competition may be serious before spring. Wheat will tolerate up to 2 pounds of 2, 4-D after full tiller and before flower in the spring; however, 1/2 pound per acre usually is sufficient to kill common broadleaf weeds.

Forestry, Woodlots, Shelterbelts

Anderson, H. W. FOREST-COVER EFFECTS ON SNOWPACK ACCUMULATION AND MELT, CENTRAL SIERRA SNOW LABORATORY. Amer. Geophys. Union Trans. 37: 307-312. 1956.

Snowpack accumulation and melt at measurement points within snow courses were related to two forest-cover variables. Water equivalent of the snowpack on April 1 of each year and melt rate after April 1 per unit of degree-days above 35° F were studied. Cover variables were the amount of shade from trees to the south of a snow measurement point and the amount of shielding from trees to the north of the point. The amount of shade was expressed as the duration of shading between April 1 and June 15, multiplied by the amount of direct solar energy which would have struck the snow surface in the absence of shading. Shielding was expressed by the ratio of average tree height to distance of the trees from the measurement point. Data from five points in each of five snow courses for three years of record were analyzed by the method of covariance. The analyses showed a high degree of association between the snowpack and forest-cover variables. The results are interpreted in terms of the timber-cutting pattern that would result in maximum accumulation of snow, minimum melt rate, and maximum prolonged release of snow water in the spring.

Baker, H. L., and Poli, A. AREA AND OWNERSHIP OF FOREST LAND IN SHASTA COUNTY, CALIFORNIA. Calif. Forest and Range Expt. Sta. Forest Surv. Release 24. Nov. 1954.

These studies were carried on under a project of the Forest Service designed to provide a comprehensive survey of the forest resources of the United States. This forest survey was authorized by the McSweeney-McNary Research Act of 1928. The reports show the extent, location, and condition of all forest lands in these counties. They include also quantitative data as to type and size of ownership, and number and kinds of owners. Highest in percentage of forest land are Del Norte County with 96 percent and Shasta with 90 percent. Lowest in San Mateo with 44 percent. The percentage of forest land that is growing or is capable of growing usable crops of wood is highest in Humboldt County with 89 percent and lowest in San Mateo with 47 percent. Del Norte County has the lowest percentage--33 percent--of commercial forest land that is privately owned. In Santa Cruz County, all the commercial forest land is privately owned. Next is San Mateo County with 91 percent in private ownership.

Bickford, C. A. STOCKING, NORMALITY, AND MEASUREMENT OF STAND DENSITY. Jour. Forestry 55: 99-104. 1957.

Stocking is a relative term based on the stand desired, while stand density is measured in absolute units on an area basis. The stand desired depends on the limitations of site and species and on what the owner wants.

Many characteristics of a stand have been used or suggested to evaluate stocking or to measure stand density. Basal area and numbers of trees by average diameter, despite some deficiencies, have been units most frequently used.

Certain measures of density are better suited to some forest types and management systems than to others.

Calif. Forest and Range Expt. Sta. Forest Surv. Release 19. FOREST STATISTICS FOR THE REDWOOD-DOUGLAS-FIR SUBREGION IN CALIFORNIA. Jan. 1953.

This report presents statistics collected as a part of the Forest Survey authorized by the McSweeney-McNary Act of 1928. It includes data on forest areas, volume of timber, growth, drain, and ownership for this subregion, as of 1948. In that year, commercial forest land totaled 4,238,000 acres. Of this, 2,922,000 acres were privately owned. The net volume of live saw timber totaled 137,553 million board feet. Average annual net growth amounted to 1,063 million board feet. The 1947-49 average annual drain of live saw timber was 1,742 million board feet; and of growing stock 315.2 million cubic feet.

Day, M. W. A STUDY OF ALDER ON FOREST LANDS IN MICHIGAN. Quar. Bull., Mich. Agr. Expt. Sta., Mich. St. Univ. Agr. and Applied Sci., Vol. 39, No. 2, pp. 301-306. Nov. 1956.

Cutting of an alder stand, leaving a scattered stand of aspen and balsam poplar with nearby conifer seed trees, resulted in the appearance of some 416 stems of poplar per acre after 10 years. While 506 balsam fir seedlings appeared, only 32 per acre persisted to the end of the first 10-year period.

Girdling of half of the alder stand gave no advantage over untreated areas.

All cuttings of alder increased the grass and weed cover and made conditions less favorable to reproduction.

Cuttings of a 10-year old stand of alder, aspen, and balsam poplar resulted in no increase in stocking of the more desirable species.

Cutting of a mature stand of well-stocked balsam poplar on the same site resulted in a full stocking of poplar which overtopped the alder sprout growth.

Other studies indicated that the invasion of alder on denuded areas by seed was slow and not a serious competitive factor, but that sprouting of established alder gave severe competition to all but the suckering and sprouting species.

Gessel, S. P., and Shareeff, A. RESPONSE OF 30-YEAR-OLD DOUGLAS-FIR TO FERTILIZATION. Soil Sci. Soc. Amer. Proc. 21: 236-239. 1957.

This paper presents the 5-year growth increment of a 30-year-old Douglas-fir stand after fertilization. Nitrogen was applied initially at the rate of 100 pounds per acre. Subsequent yearly additions have brought the total to 350 pounds. Soil nitrogen content before fertilization was 0.12% and Douglas-fir site class was a high V with a stocking of 3,500 trees per acre. Small quantities of phosphorus, potassium and lime were applied initially only.

The fertilizer treatment has resulted in the following growth modifications:

1. Accelerated diameter growth, particularly in the larger diameter classes.
2. Accelerated volume growth on both a tree and a stand basis. The fertilized stand has approached Site III in periodic annual increment.
3. Development of natural competition and more rapid suppression of small trees on the plot.
4. Fifty largest trees on the fertilized plot produced about the same periodic annual increment as the total stand on the unfertilized plot.

Hodgins, E. J. TESTING SOIL-SITE INDEX TABLES IN SOUTHWESTERN ALABAMA. Jour. Forestry 54(4): 261-266. Apr. 1956.

This paper reports a study that tested the application of soil-site index tables to longleaf, slash, and loblolly pine stand in Baldwin, Escambia, and Monroe Counties in Southwestern Alabama.

It was found that in general, the soil-site index tables of highest utility are designed for relatively small geographic areas with uniform climates and distinctive soil conditions. Such tables can be of considerable value on many areas where it is not possible to obtain reliable site indices.

Johnson, F. A., and Hicks, V. E. ESTIMATING ALLOWABLE CUT WITHOUT A TYPE MAP IN FORESTS OF WESTERN WASHINGTON AND WESTERN OREGON. Jour. Forestry 54(8): 522-524. Aug. 1956.

A method for estimating allowable cut under which area statistics are obtained by sampling rather than from a type map is described and discussed. The method was tried on two National Forest working circles.

Survey costs under the area sampling method were roughly comparable to costs found previously on other working circles under the type map method. Sampling errors for the total mature volume portion of the allowable cut estimate were also about the same under both methods.

Lay, D. W. EFFECTS OF PRESCRIBED BURNING ON FORAGE AND MAST PRODUCTION IN SOUTHERN PINE FORESTS. Jour. Forestry 54(9): 582-584. Sept. 1956.

Prescribed burning, where the understory averaged 9 to 12 feet high, reduced browse for two years, and increased herbaceous forage for at least three years in total forage production. Buring decreased yaupon, holly, blackgum, dogwood, wax myrtle, and tree huckleberry. It increased French mulberry, viburnum, Smilax, sweetleaf, blackberry, sweetgum, herbs, and grasses-sedges.

Mesavage, C., and Grosenbaugh, L. R. EFFICIENCY OF SEVERAL CRUISING DESIGNS ON SMALL TRACTS IN NORTH ARKANSAS. Jour. Forestry, Vol. 54, No. 9, pp. 569-576. Sept. 1956.

Accuracy and efficiency of timber cruises are affected independently by the choice of plot arrangement and plot size. For any given tract being cruised for a given purpose, there is one arrangement and one plot size which is optimum for that tract and that cruising purpose. This study evaluated the effects of these factors on accuracy and efficiency of cruises of small tracts in the Ozark mountains of north Arkansas and the rolling terrain in north Louisiana.

Sartz, R. S., and Trimble, G. R., Jr. SNOW STORAGE AND MELT IN A NORTHERN HARDWOOD FOREST. Jour. Forestry 54(8): 499-502. Aug. 1956.

Although this was a preliminary study, limited to gentle, northfacing slopes, basic relationships that were uncovered suggest a possible application on similar terrain. The study showed that snow accumulation in hardwood forests can be increased and melting of the snow pack prolonged by cutting narrow openings in the east-west direction.

Poli, A., and Baker, H. L. OWNERSHIP AND USE OF FOREST LAND IN THE COAST RANGE PINE SUBREGION OF CALIFORNIA. Calif. Forest and Range Expt. Sta. Tech. Paper 2. June 1, 1953.

Of the 6,330,000 acres of forest, range, and farm-forest land in this subregion, about half is commercial forest land, which carries a net sawtimber volume of 62,554 million board feet. In the northern part of the subregion, much of the forest land is publicly owned, although there are also large private holdings. In the southern part, much of the forest land is privately owned, holdings are small and uses are diversified. Timber operations constitute the major use of much of the private land in the northern part. Forests in the southern part of the subregion are a significant part of the economy because they are easily logged and are near markets. Most of the timbering throughout the region is done on the commercial forest land that is privately owned.

Ralston, R. A., and Lemien, W. PRUNING PINE PLANTATIONS IN MICHIGAN. Cir. Bull. 221, Mich. St. Univ. and U. S. Dept. Agr. Feb. 1956.

The pruning recommendations in this bulletin are aimed primarily to serve the needs of private forest plantations on farms and other small holdings limited in area, and their owners often live nearby. This class of plantation owner who, if interested, is in a favorable position to grow high-quality, high-value timber. The general principles developed here, however, are applicable to any pine and other coniferous plantations, regardless of size or type of ownership. The research and observations upon which this bulletin is based were carried out in the Lower Peninsula of Michigan; therefore recommendations apply particularly to this part of the state. It is believed, however, that they can be used to advantage elsewhere in Michigan and adjoining states.

Schantz-Hansen, T. TWENTY-FIVE-YEAR SUMMARY OF RED PINE THINNING PLOTS: CLOQUET EXPERIMENTAL FOREST. Jour. Forestry 54(8): 512-514. Aug. 1956.

This is the sixth report on four thinning plots established in 1927. For convenience all the basic data previously reported are included. The results indicate that red pine stands with a density of 1,400 trees per acre definitely begin to show some stagnation at 40 years of age. Stand densities of 500 to 800 trees per acre are still accelerating in growth at 40 years of age.

Silker, T. H., and Darrow, R. A. HARDWOOD CONTROL AND INCREASED FORAGE PRODUCTION IN SCRUB HARDWOOD-PINE STANDS TREATED WITH AERIAL APPLICATIONS OF 2, 4, 5-T AND SILVEX. Tex. Agr. Expt. Sta. Prog. Rpt. 1852. 1956.

Tests conducted during 1954-55 indicate early summer aerial applications of 2, 4, 5-T or silvex (2, 4, 5-T propionic) herbicide may be practical for controlling undesirable overstory scrub hardwoods, releasing pine and increasing forage quantity and quality on deep sand lands in East Texas. An additional growing season is desired for full evaluation of herbicide effect on overstory.

Successive yearly applications of low rates of herbicide such as 1-1/2 pounds followed by 1 pound per acre appear more effective than single applications at 2-1/2 pounds. 2, 4, 5-T and silvex gave similar defoliation and killback of the total stand of scrub hardwoods. 2, 4, 5-T gave better control than silvex of hickory, red gum and sandjack oak; silvex and more effective on blackjack and post oaks.

Sowers, D. W. SOME FACTORS AFFECTING MANAGEMENT OF CONIFERS AND HARDWOODS IN THE ALLEGHENY REGION. Jour. Forestry, Vol. 54, No. 9, pp. 563-567. Sept. 1956.

Some forest types of which conifers are a component part with hardwoods can be managed so as to increase the proportion of coniferous stocking in the stands. In other conifer-hardwood types, such as Virginia pine--Southern Red Oak and to a lesser extent the Shortleaf Pine--present knowledge and experience indicate that a choice must be made as to whether management is for pine or hardwood predominantly. This choice should be dictated by site characteristics, and no attempt should be made to encourage a species on a site is inimical to its best development. A full consideration of how the key factors mentioned influence the species being dealt with will in large part frame the management plan for any particular type and the place the component species may hold within the type.

Spurr, S. H., Young, L. J., Barnes, B. V., and Hughes, E. L. NINE SUCCESSIVE THINNINGS IN A MICHIGAN WHITE PINE PLANTATION. Jour. Forestry 55: 7-13. 1957.

Nine crown thinnings and eight low thinnings have been made at 5-year intervals in a white pine plantation on sandy outwash soil in the vicinity of Ann Arbor, Michigan. Although the four sample plots average only one-fifth of an acre, the regularity of the thinnings and the remarkable completeness of both the statistical and photographic record is noteworthy. The site index based on actual growth is 64 based on height of the tree of mean diameter at breast height. The comparable height of the dominants and codominants was 66 feet. The thinnings ranged from moderate to light, with an average of 14.9 percent of the basal area having been cut in the crown thinning plot and 9.2 percent in the low thinning plot. The thinnings have made no appreciable difference in the total cubic-foot volume produced and only slight improvement in the basal area increment in the two stands. They have rather served two purposes: first, to pre-salvage the mortality, and second, to concentrate much of the growth on the larger stems. Wood material that would otherwise have been lost has been incorporated into the remaining stems. The thinned stands have fewer stems and larger diameters than the unthinned stands. Crop trees are also larger. The mean diameter of the 100 largest crop trees per acre averages 11.6 inches in the two thinned stands and only 11.0 inches in the two unthinned stands.

Stabler, G. R. EFFECT OF CONTROLLED RELEASE ON GROWTH OF INDIVIDUAL DOUGLAS-FIR TREES. Jour. Forestry 54(9): 567-568. Sept. 1956.

This study was designed to use individual trees for observation, rather than some wind area as in more usual thinning trials. This way, the results have more than usual meaning in understanding the reactions of trees to thinning. Dominant trees responded well to release in a well stocked stand. The greatest response in terms of inches of increased growth occurred on the largest trees--that is, toward the dominant end of the scale. Apparently, the better developed crown and root system of large trees permits them to make better, or at least more immediate use of the increased room from thinning.

Tarrant, R. F. EFFECTS OF SLASH BURNING ON SOME SOILS OF THE DOUGLAS-FIR REGION. Soil Sci. Soc. Amer. Proc. 20: 408-411. 1956.

The studies summarized in this paper indicate that effects of slash burning vary with different soils and locations in the Douglas-fir region and also within an individual clear-cut and slash-burned area. Although severe burning damages some soil properties, the soil surface affected by severe burning usually represents only a small portion of the total area logged and burned. As low-grade materials are utilized more fully, a reduction can be expected in the volume of heavy fuels left after logging. This will decrease even more the small amount of soil surface damaged by severe burning.

In weighing the effects of slash burning on soil properties, consideration must first be given to the relative amounts of lightly burned, severely burned, and unburned soil surface. This is necessary to avoid the possibility of assigning to an entire area, the effects of only the most severe burning treatment.

Vlamis, J., Biswell, H. H., and Schultz, A. M. NUTRIENT RESPONSES OF PONDEROSA PINE. Jour. Forestry 55: 25-28. 1957.

The nutrient responses of ponderosa pine seedlings were studied and compared with those of lettuce and barley growing in the same forest soil. A pot test was used, where a complete fertilizer is compared with a control and subsequent treatments omit one nutrient at a time. Ponderosa pine seedlings made better growth on unfertilized soil than did either lettuce or barley, but all three species responded vigorously to a complete fertilizer--nitrogen, phosphorus, potassium--treatment.

When nitrogen was omitted all three species were retarded severely. Omitting phosphorus, however, had little effect on the pine but severely depressed lettuce and barley. Leaving out potassium had little effect on any species.

Westreld, M. NATURAL FOREST VEGETATION ZONES OF NEW ENGLAND. Jour. Forestry 54(5): 332-338. May 1956.

In recent years public and private forest surveys have marshalled a wealth of detailed type data that provide an excellent basis for compiling natural vegetation maps on a regional basis. This article outlines the method and principles used in preparing such a map for New England. Presented also are descriptions of the forest vegetation zones established and an allocation of Society of American Foresters forest cover types to the established zones.

Economics of Conservation

Anderson, J. R. LAND USE AND DEVELOPMENT--SOUTHEASTERN COASTAL PLAIN. U. S. Dept. Agr. Agr. Inform. Bul. 154. May 1956.

This report deals with land use and possibilities for land development and improvement in the southeastern Coastal Plain. Facts about the land resources of this region were brought together from many sources. These facts are analyzed in light of the need for a better understanding of the changes in land use that are occurring in the Coastal Plain and of the potentialities for further land development and improvement.

Botts, R. R., Rush, J. D., and Ellickson, J. C. FARMERS' MUTUAL FIRE AND WINDSTORM INSURANCE IN THE UNITED STATES. U. S. Dept. Agr. Agr. Inform. Bul. 165. Oct. 1956.

At the end of 1954, fire insurance carried by farm mutuals totaled about $28.8 billion. About 85 percent of this insurance was on farm property. From 1944 through 1954, the fire insurance of these companies increased at a rate of about 8.6 percent a year. Windstorm insurance offered by around a third of the companies totaled about $11.4 billion at the end of 1954. The trend is apparently toward the fire-wind type of company, rather than toward specialization in either fire or wind insurance. Specialized farmers' mutual windstorm insurance companies had about $7.7 billion of such insurance in force, of which about 91 percent was on farm property. The companies are growing more nonfarm in character, particularly in the Northeast; about 7 in 10 still have 90 percent or more of their insurance on farm property. Insurance coverage is limited to three-fourths of the value of the property by about three-fourths of the companies. The 5-year policy is still used predominantly. Around three-fourths of the companies use only one rate on farm property. Most of the companies inspect the farm property before they accept it for insurance, but this is done less now than in 1936. Since 1914, losses paid per $100 of insurance have declined, while operating expenses have increased. In 1954, insurance costs to farmers were lowest in the Corn Belt and Lake States, and highest in the Appalachian, Delta, and Southeastern States. More of the larger than of the smaller companies use reinsurance in connection with both fire and wind insurance.

Bouwer, H., and Helms, J. O. FLEXIBLE TUBING IN SPRINKLER IRRIGATION. Agr. Engin. 38: 794-799. Nov. 1957.

Flexible tubing was used in an experimental sprinkler system in the form of branched flexible laterals, branched aluminum laterals, and flexible laterals. The labor requirements with branched flexible and branched aluminum laterals for irrigation of tall corn were 0.4 and 0.6 man-hours per acre per irrigation, respectively, as compared with 1.0 man-hours with a hand-move aluminum lateral. Flexible laterals required a moving time of 0.7 man-hours per acre per irrigation in pasture. Use of flexible tubing also eliminated the need for carrying metal lateral pipe, and reduced the waling distance for moving sprinklers.

Smaller pipe sizes can be employed for laterals equipped with branches, since excessive pressure variations in the lateral can be offset by controlled friction losses in the branches. The design procedure for branched laterals is discussed and illustrated with an example.

An economic analysis for a hypothetical case with black polyethylene pipe as flexible tubing shows that the estimated useful life of the branched flexible lateral necessary for equal net profit as compared with a conventional system must be 2 to 10 years, depending on cost of labor and equipment utilization. Cost estimates for a branched-aluminum-lateral system for the same case shows that the cost of the branches was entirely offset by the saving in control valves. Because of difficulty in assigning concrete values to the effect of use of flexible tubing on the utilization of the system and on the human energy requirements for operating the system, the selection of using flexible tubing must be partially guided by personal views of the irrigator.

Black polyethylene tubing was used in an experimental system to determine principles of operation and labor requirements. In selecting or developing flexible tubing for use in sprinkler irrigation, working pressure, durability, available sizes, flexibility, weight, and cost are factors to be considered. The results with the experimental systems indicate, however, that suitable flexible tubing may serve as a tool of improving the labor aspects of irrigation with portable sprinkler systems.

Brodell, A. P., and Cooper, M. R. POWER AND MACHINERY ON FARMS, AND RELATED DATA. U. S. Dept. Agr. Agr. Res. Serv., Prod. Econ. Res. Br. Bul. ARS 43-26. Apr. 1956.

This report contains the available data on numbers and State distribution of several principal farm machines and numbers and State distribution of horses and mules on farms since 1910. The report also shows the number of farms, by States, and farmers' annual purchases of motor vehicles, farm machines, and equipment, by census years, beginning with 1910.

Reports and material of the Bureau of the Census, the Production Economics Research Branch, Agricultural Research Service, U. S. Department of Agriculture, and the Agricultural Estimates Division, Agricultural Marketing Service, U. S. Department of Agriculture, were used in the preparation of this report.

Butler, C. P. SOME ECONOMIC EFFECTS OF COTTON ACREAGE DIVERSIONS IN THE PIEDMONT AREA OF GEORGIA AND SOUTH CAROLINA, 1953-1955. S. C. Agr. Expt. Sta. Bul. 440. Sept. 1956.

The acreage of cotton in the Piedmont area of Georgia and South Carolina declined from 2,342,068 acres in 1930 to 727,990 in 1952. This downward trend was due only partly to control programs. Although the allotment in 1954 was 636,434 acres, only 533,870 acres were planted. Other factors have been greater nonfarm employment opportunities; competition from cotton grown in other areas with relatively greater advantages; and the relatively greater progress in adapting mechanization to the production and harvesting of other crops. The reduction in acreage of cotton has been accompanied by changes in systems of farming, although these changes have not been uniform on farms of all sizes. Even with the reduced acreage, Piedmont cotton farmers had higher net returns from cotton in 1955 than in 1953. Consequences of the allotment program have been no more severe on croppers than on landowners. About 40 percent of the land diverted from cotton since 1953 in the Piedmont area was idle in 1955. The increased labor resources available were even greater. Cotton farmers in this area need more opportunities for nonfarm employment, consolidation of small farms, and incentives to make fuller use of their resources compatible with national needs. Current research shows that these farmers can increase their incomes through better management and through selection of profitable alternatives uses of the resources diverted.

Butler, C. P. THE BUSINESS SIDE OF PRODUCING BEEF CALVES IN THE PIEDMONT AREA OF SOUTH CAROLINA. S. C. Agr. Expt. Sta. Bul. 426. July 1955.

A representative medium-sized farm was selected for a budget analysis of production alternatives. It contained 132 acres, with 74 acres of cropland. Results showed that the beef cattle enterprise is well adapted to a combination system of farming with small grains, which provide winter grazing. Under the price-relationships that prevailed in 1955, using all open land for grazing crops to support a beef cow-calf enterprise devoted to production and sale of calves would not be profitable. But as a supplementary enterprise to a cash-crop system of farming, production of beef calves would be profitable. Changes in price relationships affect the comparative profitableness of alternative systems. For example, with cotton at 35 cents a pound and oats at 80 cents a bushel, prices of beef cattle would need to be $15 or more per 100 pounds to make it profitable to add a beef cow-calf enterprise to a representative cotton-small grain system on a medium-sized farm. The price combination of cotton at 25 cents a pound, oats at 50 cents a bushel, and beef cattle at $10 per 100 pounds, would be a point of indifference so far as returns to the operator are concerned, in deciding what alternative system to choose. The conclusion reached is that production of beef calves as a supplementary enterprise is likely to increase in scope and importance in the area.

Chryst, W. E., and Timmons, J. F. ADJUSTING FARM RENTS TO CHANGES IN PRICES, COSTS, AND PRODUCTION. Iowa Agr. Expt. Sta. Spec. Rpt. 9. April 1955.

Basic information for the study reported here was obtained from farm records of tenants and landlords cooperating in the Iowa Farm Business Associations over a period of at least 15 years. These records provided the basis for calculating net returns ratios from 1921 through 1950. The analysis of rents on these farms showed that there are two main reasons as to why rents fail to keep pace with prices, costs, and production: (1) Wide fluctuations in net ratios; and (2) the fact that the kind of rent affects the direction of the trend in net return ratios. Interviews with 90 landlords and tenants revealed that they had made 165 adjustments growing out of rent inflexibilities since 1939. Some of them were successful. Most could have been avoided if leases had contained adjustment provisions. Landlords and tenant used three kinds of specific provisions designed to adjust rents to changes in income: A base and bonus idea; a cash or share-option idea; and a commodity price adjustment idea. State experiment stations have advanced other ideas--adjustments in keeping with changes in the "prices received" index, and adjustments based on changes in both price and production.

The authors believe that landlord and tenant should work out the arrangement ahead of the leasing period to which it is to apply, state it clearly in writing, and both should agree to it. The arrangement should encourage efficient use of farm resources; provide for changes in prices of farm products; provide for changes in farm production beyond the control of the farmer; and be readily workable and not unduly complex.

Ciriacy-Wantrup, S. V., and Schultz, A. M. PROBLEMS INVOLVING CONSERVATION IN RANGE ECONOMICS RESEARCH. Jour. Range Management 10: 12-16. 1957.

Range economics must deal with the long term view rather than with immediate profits. Range research to date has dealt with the mathematics of agronomy and animal husbandry and most of the winning cards have been drawn from the deck of immediate profits. Often these are long term effects which are not possible to measure at once. These facts are particularly true of conservation measures on the range which may have had lasting effects on the water supply for some city, upon the value of the land for recreation or wildlife, or that may save the soil.

Crowe, Grady, B. SPECIFIED PRODUCTION COSTS FOR COTTON AND ALTERNATIVE CROPS, YAZOO-MISSISSIPPI DELTA. Miss. Agr. Expt. Sta. Mar. 1956.

This report represents a revision of a similar report issued in 1949 and revised and reissued in 1953. This further revision attempts to bring the earlier reports up to date in terms of prices and changes in production practices. Where practices have changed or additional data collected have indicated a change, the earlier reports have been modified.

Davis, J. F., and Staniforth, S. D. ELECTRICITY ON FARMS IN THE EASTERN DAIRY AREA OF WISCONSIN. U. S. Dept. Agr. Agr. Inform. Bul. 143. Oct. 1955.

The study reported here is one of a series of related studies made in different type-of-farming areas. The study area contained 19 counties, with 54, 388 farms. Of these farms, 52,482 had electric service from a powerline, according to the census of 1950. In 1949, on the average, 4-233 kilowatt-hours of electricity were consumed per farm, or 238 percent more than in 1940. The average cost per farm for electricity used in 1949 was $122.09, or 2.88 cents per kilowatt-hour. From 1940 to 1949, average consumption of electricity per farm increased at the fairly constant rate of 14 percent a year. Dairy farms used more electricity in 1949--4,686 kilowatt-hours--than any other type of commercial farm. The number of kilowatt-hours used was related to size of farm. Seasonal use varied little, but somewhat more electricity was used in the first half of the year than in the last half when allowance is made for secular trend. Of all electricity used in 1949, around 59 percent was used for operating household equipment, and around 26 percent for operating farm equipment. Dairy farms had more pieces of electrical equipment for use in service buildings and service areas than any other type of commercial farm. Milking machines, milk coolers, and water heaters were important kinds of electrical equipment on dairy farms. Farm shop equipment was reported on farms of all types. Electric ranges, refrigerators, and home freezers accounted for about 40 to 45 percent of all electricity used on these farms in 1949. Electricity was used for lighting on all farms in the area.

Elrod, J. C., and Fullilove, W. T. CROP PRODUCTION PRACTICES AND COSTS IN GEORGIA. Geo. Agr. Expt. Sta. Bul. N. S. 24. July 1956.

Increased emphasis on farm planning and adjustments in farm organization has resulted in a need for better and more up-to-date information on crop production practices and costs including labor and power requirements. In order to meet this need, a study was initiated during the summer of 1948 for the purpose of obtaining data on crop production practices in the major type-of-farming areas of the State. At the outset, such information was not available for many crops grown in Georgia and data available for other crops were either inadequate or out-of-date. This study should furnish some basic crop enterprise data which can be used as a guide in farm planning and adjustment activity.

The report is based on information collected by the survey method at various times since 1948. The crop enterprise schedule used covered such items as the production operations performed, date and rate of performance, type of power and equipment used, and kind, amount, and cost of input items.

L. K. Gauger, J. Muehlbeier, and K. Kristjanson. LAND SALES AND ASSESSED VALUES IN NEBRASKA, 1930-52. Nebr. Agr. Expt. Sta. Misc. Pub. 3. Jan. 1954.

This report shows the trend in prices of farmland in Nebraska from 1930 to 1952; the relationship between sale prices and assessed values of land; and a comparison of land prices and number of transfers based on actual sales with land values from the U. S. Census and estimates from the Production Economics Research Branch, ARS (formerly a part of the Bureau of Agricultural Economics). The average price of land in Nebraska fell from $50 an acre in 1930 to $19 in 1941, then rose to 66 by 1952. After 1941, a rise set in and by 1952, the price had reached an average of $66 an acre. The average assessed value of farmland in Nebraska fell from $36 an acre in 1930 to $24 in 1933. By

1940, it had dropped to $22, where it became relatively fixed for the rest of the 23-year period. The assessed value as a percentage of the sale price of farmland in the State was highest in 1940 and 1941, when it reached 113 percent, and lowest in 1951 and 1952, when it was 38 and 35 percent, respectively.

Goodsel, Wylie D., et al. FARM COSTS AND RETURNS, 1955 (WITH COMPARISONS). COMMERCIAL FAMILY-OPERATED FARMS, BY TYPE, AND LOCATION. USDA. Information Bull. No. 158. June 1956.

This bulletin presents summary results of farm operations in 1955 on 27 important types and sizes of farms in major farming areas in the United States. Twenty-three of these farms are average commercial family-operated farms of a particular type located within comparatively homogeneous farming areas. Four are size-type commercial family-operated farms. These are the large-scale and small cotton farms in the Mississippi Delta area and the small tobacco and large tobacco-cotton farms in the Coastal Plains of North Carolina.

Gray, J. R. SOUTHWESTERN CATTLE RANCHES: ORGANIZATIONS, COSTS, AND RETURNS. New Mex. Agr. Expt. Sta. Bull. 403. Feb. 1956.

This bulletin contains information on costs and returns, production rates and practices, and investments; details of investments, costs, and returns; procedures and measurements of outputs and inputs; and indexes of production, costs, and returns.

Hady, F. T., Nodland, T. R., and Pond, G. A. FARM POULTRY FLOCK RETURNS, 1947-1952. Minn. Inst. Agr. Dept. Agr. Econ. Rpt. 212. Dec. 1953.

Feed costs and returns from an average of 440 farm poultry flocks for the years 1947 to 1952 are presented in this report. The total cost of feed per hen averaged $4.51. In 1952, the cost was $5.03; highest was $5.07 in 1947 and lowest $4.15 in 1950. Return above feed cost per hen averaged $1.58. In 1952, this return was only $0.84, lowest of the 6 years. Highest return was in 1949 at $2.40. Return per $100 worth of feed consumed averaged $135. Highest return was in 1949 with $164; lowest was in 1952 with $117.

Hansing, F. D., and Gibson, W. L., Jr. BECOMING A FARM OWNER. IS IT MORE DIFFICULT TODAY? Va. Agr. Expt. Sta. Bul. 473. June 1955.

The study reported here is based on data obtained from 160 farm owners in Culpeper and Orange Counties, Va. Dairying and production of beef cattle predominate on these family-sized farms, with capital investments that averaged more than $30,000 in 1950. The farmers interviewed provided data on their farms as at the close of the year 1951 and at the time they bought or otherwise acquired their farmland. About two-thirds of the present owners of these farms received financial assistance from their families in acquiring ownership of their farms. This assistance took the form of inheritance, a loan of capital for purchase of a farm, or an opportunity to work on the home farm until enough capital had been accumulated to finance a farm business. A third of the farmers received no financial assistance from their families; they acquired the capital to make a downpayment on the farms they bought by working at nonfarm employment, borrowing all of their initial investment, or climbing the traditional agricultural ladder. Economic conditions and the level of employment greatly influenced the ability to accumulate capital for farming from nonfarm income. By 1951 these farmers had been successful in retiring the indebtedness assumed when they bought their farms, and were able to acquire additional capital to develop and expand their businesses. The operators' equities in their farms increased substantially, even though the average farm investment more than doubled since the farms were bought. Farmers who received family help began with farms valued at $6,566, in which they had a 66-percent equity. By 1951, they had an 89-percent equity in farms valued at $14,718. Those who began without family help improved their financial position from a 52-percent equity in a $6, 529 busines to an 84-percent equity in a $14,012 business.

Heady, E. O., Olson, R. O., and Scholl, J. M. ECONOMIC EFFICIENCY IN PASTURE PRODUCTION AND IMPROVEMENT IN SOUTHERN IOWA. Iowa Agr. Expt. Sta. Res. Bul. 419. Dec. 1954.

A birdsfoot trefoil-orchardgrass combination and a lespedeza system of pasture production may last for 20 years if fertilizer is added periodically. An alfalfa-brome-ladino system and a reed canary-ladino system would last for 5 years. When all costs over a 20-year period are taken into account, the two 20-year systems appear to be the least expensive. The average cost per year, based on 1951 prices, would be $3.92 per acre for the birdsfoot trefoil-orchardgrass combination, $294 for the lespedeza, $7.09 for the alfalfa-bromegrass-ladino mixture, $6.55 per acre for the reed canarygrass-ladino system, and $9.54 for the clipping and fertilization. Discounting the costs at 5 percent would mean lower costs for the two 20-year systems but the difference between these and the 5-year systems would be slight. Discounting at 20 percent would greatly lower the costs of the 20-year systems. Improvement of many pastures in southern Iowa will depend on clearing the land of brush and trees. Costs of clearing would vary from about $25 per acre for light brush to several hundred dollars per acre for dense woods with trees 10 inches or more in diameter. Yields of pasture fluctuate from year to year. Farmers usually limit their livestock to the number their pastures can handle in average or poor years. About 85 percent of the farmers in the area believe that improvement of their permanent pastures would pay. Lack of capital and the livestock to utilize more pasture often keep them from making improvements. Many of them could increase their returns by renting additional pasture.

Heneberry, W. H., Sauer, E.L. SUMMARY OF FARM BUSINESS RECORDS FROM 131 FARMS IN THE NORTHEASTERN ILLINOIS SLOWLY PERMEABLE SOILS AREA, 1953. Ill. Agr. Col. Dept. Agr. Econ. AE 3010. 1954.

This report is the ninth in a 10-year study of the economics of soil conservation in a slowly permeable soils area. Much progress has been made by the farmers in the study in controlling erosion and building up the fertility of the soils in their farms. Data in this report are based on farm account records obtained from 131 farms in Ford, Livingston, Iroquois, Will, LaSalle, Vermilion, and Champaign counties. Because of the slow permeability of the subsoil in the area, drainage is poor, and there is much erosion. As a result, crop yields are substantially below those on surrounding soil types under similar management. An increasing number of farmers in the area are using soil conservation plans to control erosion and maintain or increase productivity. Increased use of fertilizers is helping to raise yields of both grain and forage crops.

Janssen, M. R., and Robertson, L. S. PROFITABLE ALTERNATIVE SYSTEMS OF FARMING ON A LEVEL CENTRAL INDIANA FARM. Ind. Agr. Expt. Sta. Bul. 636.

The 168-acre farm selected for study is typical of about 3,400 farms in the Central Grain and Livestock Area of Indiana. Objective of the study was to learn the relative profitability of several alternative cropping and livestock systems, with and without applications of commercial nitrogen that can be followed on such farms. Results of the study indicated that selection of more profitable cropping systems, better fertilization practices, and more desirable livestock combinations and practices can increase labor income from $2,399 for the present system to $6,338 for an improved farming system under average management. Capital needs would increase by $7,847 for the most profitable system. The most profitable combination with applications of phosphate and potash would be to have about four-fifths of the farm in grain crops.

Jensen, H. R., Heady, E. O., and Baumann, R. B. COSTS, RETURNS, AND CAPITAL REQUIREMENTS FOR SOIL-CONSERVING FARMING ON RENTED FARMS IN WESTERN IOWA. Iowa Agr. Expt. Sta. Res. Bul. 423. Mar. 1955.

A study of 40 rented farms in western Iowa showed that: (1) The tenant's net income is increased by adjusting to soil conservation farming, regardless of the leasing system used; (2) the tenant's net income from a soil-conserving farming system that included a dairy-hog program was larger under a crop-share lease than under a livestock-share lease; (3) the landlord's net income was increased by adjusting to soil-conserving farming system under a livestock-share lease but not under a crop-share-cash lease. On these farms, the leasing system affected the average net incomes of the landlords. The customs and traditions that have grown up around leasing systems and that may prevent farmers from adjusting to soil conservation farming were analyzed. Modifications suggested to promote economic efficiency include (1) Increased length of lease and security of tenure when feasible; (2) inclusion of compensation provisions for unexhausted resources furnished by tenants; (3) collection by the landlord of improvement rent or an increase in his share of the product, or sharing with the tenant the added costs and added returns, so that the tenant will be encouraged to invest in buildings, terraces, and tile; (4) landlord-tenant sharing of variable costs in the same proportion as receipts in the short run and sharing receipts in proportion to resources furnished in the long run to encourage optimum intensity of production; (5) discouraging of transfers within the business by relating rental charges for the services of specialized resources directly to their productivity.

North Central Land Tenure Resources Committee. CONSERVATION ON RENTED LAND IN THE MIDWEST. Kan. Agr. Expt. Sta. Bull. 377. Feb. 1956.

More than 40 percent of the land in farms in the North Central states is rented. Data indicate that conservation generally has not progressed so far in rented as on owner-operated land. This suggests the desirability of examining landlord-tenant agreements that relate to conservation.

Outlook and Situation Board. CURRENT DEVELOPMENTS IN THE FARM REAL ESTATE MARKET. ARS 43-32 (CD-43). Mar. 1956.

Values of farm real estate in the United States averaged 1 percent higher during the 4 months ended March 1, 1956. Increases were common in the Eastern and Southern States. Values were essentially unchanged in the States of the Corn Belt, Lake, and Appalachian regions, but declined in the Great Plains. The March 1, 1956, national index was 138 percent of the 1947-49 base period. This was a new record high and 4 percent above the post-Korean peak of 1952. New record highs were established in 21 States this March.

Reuss, L. A. RECENT TRENDS IN NUMBER, SIZE, TYPE, AND VALUE OF FARMS IN FLORIDA. Agr. Econ. Mimeo Rpt. No. 56-8. June 1956.

This presents in text and graphs, a condensed review and interpretation of recent trends in number, size, type, and value of farms in the State of Florida and its four districts--Northwest, Northeast, Central, and South Florida.

Synder, J. H., and Weeks, D. SOIL PRODUCTIVITY RATINGS IN ECONOMIC ANALYSIS. Soil Sci. 82: 101-115. 1956.

Most of the data were obtained either by direct field observation of farmer interviews. Information was obtained from 33 producers within the Pajaro Soil Conservation District on land utilization; apple production by varieties; orchards by variety, age, and planting pattern; and tillage operation, conservation practices, fertilization, and spray programs, and other inputs in terms of material and man-, machine-, or tractor-hours. These data reflect 6 to 8 years of conservation farm practices. Emphasis here is placed on measuring soil properties in a way useful in economic analysis. Soil classification and productivity ratings are discussed before soil properties and profile variables are analyzed.

Southern, J. H., and Adkins, W. G. THE TEXAS FARM AND RANCH LAND MARKET, 1953. Tex. Agr. Expt. Sta. Prog. Rpt. 1696. June 1954.

A study of deed records of all bonafide sales of farm property in 24 sample counties showed that uncertainty was the dominant feature of the Texas land market for 1953. The main causes of this uncertainty were falling prices for beef cattle and the 3-year-long drought. The number of sales was 15 percent lower than in 1952, and the lowest since

1940. The total acreage sold was the smallest since 1935. The average price paid for land was $71.57 per acre in 1953, 5 percent above 1952. This was the highest average price reached since record keeping began in 1920. Farmers were the chief buyers of farmland. Most of them were owner-operators who were in fairly strong financial positions and could easily meet the downpayments required.

Southern, J. H., and Miller, R. L. OWNERSHIP OF LAND IN THE COMMERCIAL TIMBER AREA OF SOUTHEAST TEXAS, 1955. Tex. Agr. Expt. Sta. Prog. Rpt. 1853. 1956.

Ownership of land in the 14-county commercial forestland area of Southeast Texas was determined for use in timber management programs and research. Ninety percent of the total area of about 8 million acres is owned by individuals and corporations.

Fifty-two percent of all private owners hold tracts of 20 acres or less, totaling only about 4 percent of the private lands. Forested acreage owned by this group is of minor importance. At the other extreme, less than 1 percent of the owners have holdings over 5,000 acres in size and they own 47 percent of the privately-owned land. Extensive timber acreage is held by these large owners and it is under relatively good management.

Sutherland, J. G., and Bishop, C. E. POSSIBILITIES FOR INCREASING PRODUCTION AND INCOMES ON SMALL COMMERCIAL FARMS, SOUTHERN PIEDMONT AREA, NORTH CAROLINA. N. C. Agr. Expt. Sta. Tech. Bull. 117. Dec. 1955.

This report is based on schedules obtained in 1951 from 120 farms selected at random from a list of farms classified as commercial according to the census definition of a farm. It was found that most small farms in the Southern Piedmont area of North Carolina were not organized and operated in a way consistent with their productive potentials. Net revenues obtained were inadequate to provide a socially desirable level of living for the farm families. Approximate potential net revenues were established for farms with 15, 27, and 50 acres of cropland. Most of these optimum organizations would include laying hens, cotton, corn, oats, lespedeza, and alfalfa. Potential net revenue would range from about $5,800 on nonmechanized farms with 15 acres of cropland using family labor only to $10,350 on mechanized farms with 50 acres of cropland using family labor and one full-time hired man. Estimated additional capital required would range from about $7,000 to $19,500 per farm for the two kinds of farms. Additional labor needed on farms with 27 acres of cropland operated with family labor only would be approximately 1,700 man-hours. Laying hens would provide a substantial part of the total net income for all optimum organizations. Results of the study indicate that additional investment on these small Southern Piedmont farms would be highly productive. An extensive educational campaign would be needed, however, before many would take advantage of the opportunity to increase the investment of capital on their farms to the extent that would be profitable. Individual farm planning would be required. However, the plans developed in this report could serve as models.

Wis. Agr. Col. GRASS SILAGE: WISCONSIN FARMERS' METHODS, COSTS, AND RESULTS. Wis. Agr. Col. Dept. Agr. Econ. Agr. Econ. 10. Mar. 1954.

This report is based on replies to a questionnaire mailed by the Federal-State Crop Reporting Service in Wisconsin to more than 800 farmers who were believed to have put up grass silage in 1948. Information was also obtained from 34 account-keeping farmers on their 1949 production of grass silage. Information on harvesting and other methods and costs were obtained by visits to about 80 farmers in Sauk and Monroe Counties in June and July of 1949 and to 87 farmers in Sauk County in the summer of 1950. Several bottlenecks were noted which apparently were responsible for retarding the increased use of grass silage. The first of these was uncertainty on the part of many farmers as to results. The second had to do with the availability and cost of modern harvesting equipment; and the third with the lack of silo capacity and strength. Of the farmers who used grass silage, 34.8 percent thought it better than corn silage; 47.4 percent thought it equal to corn silage; 12.3 percent considered it poorer than corn silage; and 5.5 percent had no opinions concerning its desirability.

Wooten, H. H., and Anderson, J. R. MAJOR USES OF LAND IN THE UNITED STATES. U. S. Dept. Agr. Agr. Inform. Bul. 168. 1957.

This publication is intended to supply an account of the extent and distribution of the major agricultural land uses and a general analysis of the land use situation in the United States as of 1954. A brief digest of the basic data for the various major uses of land is presented along with 21 summary tables for the United States as a whole and for the major geographic divisions and farm-production regions. This is followed by a series of 22 tables on major uses of land by States, as grouped by regions.

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